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The MONTHLY REVIEW

Published by the

American Electro-Platers' Society

A SOCIETY FOR THE ADVANCEMENT OF THE SCIENCE OF ELECTRO-PLATING

Entered as second class matter at the Post Office at Springfield, Mass., September 8, 1930, under Act of August 24, 1912.

Acceptance for mailing at special rate of postage, provided for in section 1103, Act of February 28, 1925, authorized September 3, 1926.

JUNE 1935

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The MONTHLY REVIEW

Published by the
AMERICAN ELECTRO-PLATERS' SOCIETY

Publication and Editorial Office
90 Maynard St.
Springfield, Massachusetts

VOL. XXII JUNE 1935 NO. 6

THE 23rd ANNUAL CONVENTION

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The International Fellowship Club as usual will hold open house on Monday June 10 at the Stratfield Hotel and this event alone needs no comment other than to say it is being hailed each year as one of the big attractions of the Convention.

The Master Electroplaters' Institute of the U. S. will hold its second annual meeting in Bridgeport June 8-9. Many of the members of this organization will participate in the doings of the Convention renewing acquaintances and sharing the benefits of the social and educational program.

A fine time has been prepared for the entertainment of the ladies, and a series of rest and recreation events for the men between the educational sessions.

Everyone should visit the Mosque Temple to see the exhibits, all the leading supply houses in the country are represented. The business as well as the educational sessions should be attended by the delegates as matters of importance to the future welfare of the organization will come up for discussion and action.

Plant visits have always had a prominent part in the Convention program and this year The International Silver Co., Bridgeport Brass, and American Tube and Stamping Co. are among the factories that are kind enough to welcome the members of the A. E. S.

Looking at the program as it appeared in the May issue of the REVIEW, the 23rd Convention of the A. E. S. should be the best one yet. Carrying the enthusiasm displayed in Detroit last year into this year's meeting in Bridgeport, we look forward with an optimistic spirit, determined to solve the problems and grasp the opportunities which present themselves.

Each Convention finds us better fitted to "do things" in the great field of Chemical Science of which we are an important part. We have made remarkable progress in the last decade, there are new worlds to conquer and the order is still "Go Forward."

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"*The Detergent Properties of Alkalies, Particularly* **Plating Cleaners**"

By MR. N. PROMISEL
The International Silver Co.
Meriden, Conn.
Read at Detroit 1934 Convention

I AM sure it is needless for me, in addressing a group of electroplaters, to stress the importance of the part of cleaning before electrodeposition. You are all aware of the rigid necessity of securing a surface that is chemically clean, that is, free from all foreign matter and undesirable films both visible and invisible, before the article concerned enters the plating solution. For this purpose research and experience have established numerous procedures, involving solutions of soaps, alkalies, acids, and solvents, and mechanical contrivances of various sorts. To date at least, in the plating room, the alkaline detergent is one of the most, if not the most, important part of the cleaning procedure.

It is accordingly to this particular phase of the subject that our attention has been directed. Our aim was to study in the laboratory the requisites of an ideal cleaner and the important detergent properties of numerous representative alkaline salts. Our hope was that the data so secured would lead us directly to formulae for improved, more efficient, and more economical alkaline cleaners or at least that some of the mystery enveloping the role played by the various alkalies in the too numerous cleaners available would be dispelled.

ANALYSIS OF THE PROBLEM

Let us assume that the articles to be plated have been properly polished or finished. In the particular subject of interest to us, mainly non-ferrous metals, tripoli was often the last abrasive employed and in many cases the articles had been washed in a soap solution before being sent to the plating room. They might then have been stored for some time. Accordingly we have these factors to consider in formulating a detergent solution:

(1) *The nature of the foreign matter to be removed.*

The metal surfaces may contain residues from the buffing operations such as natural abrasives, mineral oil, stearic acid, tallow, lint and finely divided metallics. In addition the articles may have tarnished, thus possessing on the surface films of metal salts or oxides from atmospheric oxidation, or other visible or invisible films. Finally the soap used in the preceding washing may remain, giving rise, on "aging", to insoluble organic products and "soap rings".

(2) *The composition of the metal to be cleaned.*

Naturally the chemical composition of the metal must be considered in the light of possible reaction with the alkalies. Illustrative of the metals that we are concerned with are: nickel silver, brass, copper, the white metals such as tin-antimony alloys, the soft metals such as solders containing for the most part lead and tin.

(3) *Shape, size, and design of articles.*

Articles of intricate shape, complicated design, or large size undoubtedly have buffing compounds more solidly packed on them than simple pieces which have all their sections easily available to the buff wheel. Because of the inaccessibility of certain parts of these intricate pieces the cleaner must do practically all the work to the exclusion of hand or mechanical action.

(4) *Composition of the Cleaner.*

Naturally this is the main feature. There are many alkaline salts and other substances available for metal cleaning. The determination of a correct combination of certain of these and their individual concentrations forms the principle objective of this problem.

(5) *Temperature of the cleaner.*

A fairly high temperature is usually assumed for alkaline cleaners. In the first place, the chemical reactions involved are thus accelerated. Then the electrical conductivity of the bath is improved — an advantage in those cases where current is used to improve the cleaning. Thirdly, some of the dirt, such as the binder in tripoli cake, may actually melt in the cleaner and thus be removed physically. Finally, other reactions such as colloidal adsorption, solubility of the constituents, etc., may be considerably improved.

(6) *Time of immersion of the articles.*

The solution which cleans in the shortest time is of course desirable on that account usually because of the increased speed of production or the smaller cleaner capacity necessary. Furthermore, the possibility of attack of the base metal is reduced to a minimum.

(7) *Agitation or mechanical action.*

A cleaner may be used merely as a soak with or without mechanical agitation, or electric current may be passed through it and the gas evolved used for agitation or its mechanical scrubbing effect. If direct current is used, the article is usually made the cathode to retard any corrosion of the metal and to take advantage of the fact that the volume of gas liberated at the cathode is twice that at the anode.

(8) *Electrochemical effects of the current.*

Besides the mechanical use of the current as described above, certain electrochemical reactions may take place. Thus the reducing action of the cathode may at times remove the metal oxide film that may be present on the metal surface. Also momentary anodic action may be used to remove certain things that may have been deposited, removal taking place either by electrochemical dissolution, or by subsequent electrophoresis.

(9) *The use of two cleaners.*

Under certain conditions, it may be advisable to remove the dirt with a strong cleaner which in turn may leave a film on the metal. It may then be possible to follow up with a weaker cleaner, removing the undesirable film, and leaving the metal chemically clean.

A second cleaner is many times advisable for another reason. A first cleaner may become rapidly contaminated with dirt or otherwise deteriorate and its efficiency drop considerably. Its use may be continued, however, if a second cleaner is used to complete the cleaning work unfinished in the first. When it becomes no longer possible to use the first tank of solution, the solution is removed, the second tank emptied into the first and fresh cleaner made in the second. In this way the ulitmate cost of the cleaner may be appreciably reduced.

Besides the above factors in cleaning, it is important also to consider the general methods by which cleaning may be accomplished. These methods may be broadly divided into four

types though very rarely is only one type called into play in a particular cleaner. These types may be designated thus:

(1) *The type that cleans by dissolution.*

This group is comprised mainly of the organic solvents either in the liquid or vapor phase, for grease and oil. Their use is already well established.

(2) *The type that cleans by chemical action.*

The important cleaners of this type are those alkalies which react with saponifiable matter on the metal to form a soap which to a great extent is soluble under the existing conditions. Sodium hydroxide is such an alkali. In a cleaner the typical saponification reaction is:

$$R.COOH + NaOH = R.COO\ Na + H_2O$$

Fatty acid + alkali = Soap + Water

Other reactions besides saponification are also possible such as the formation of complex salts or compounds analagous to zincates or aluminates.

(3) *The type that cleans by emulsification.*

Emulsification is a phenomenon intimately connected with the field of colloidal chemistry. Its main function is that of removing from a metal surface non-saponifiable matter such as mineral oils by dispersing the oil into numerous droplets throughout the cleaning solution. If there is present a suitable colloid, such as soap, the interfacial tension is lowered allowing these droplets to be easily formed and the tendency to recombine thus diminished. Simultaneously, a film envelopes each particle or droplet dispersed thus hindering them from coalescing. It is obvious that an active agitation materially assists the original dispersion of the dirt or oil, thus increasing the emulsification effect.

(4) *The type that cleans by mechanical action.*

This require little comment. Cleaning is done by mechanically removing the dirt from the surface as by swabbing, scrubbing, gas evolution, swilling, etc.

As has been remarked, in general more than one of these types are simultaneously employed. It would appear that emulsification and colloidal action are perhaps the most important.

We may deduce from the above considerations that it would be of advantage to investigate the following properties of detergent solutions:

(1) *Wetting.*

A detergent solution to properly clean must "wet" the dirtied surface. The degree of wetting of a liquid in contact with a solid depends mainly on the relative values of the interfacial tensions involved. The smaller the liquid-solid interfacial tension the greater is the wetting power.

(2) *Displacement of oil from surface.*

This effect is the resultant of two detergent properties in the case of an oil which is insoluble and chemically non-reacting; the first is a function of the wetting power and the second is the property of emulsification.

(3) *Emulsification.*

This has been discussed above.

(4) *Chemical Activity.*

This has also been discussed above especially in connection with saponification.

(5) *Dissolving power.*

This likewise has been discussed.

(6) *Deflocculation and redeposition.*

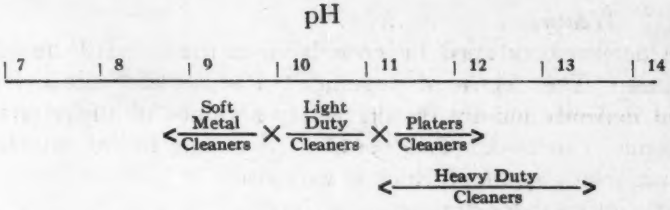
Deflocculation is the dispersion with subsequent suspension of dirt in a solution. Redeposition is the act whereby the dirt returns either to the original piece or to another piece immersed in the solution. Both these properties are of prime importance since upon them depends the success of maintaining cleaned articles clean.

(7) *Solubility of the cleaner components in cold water.*

This property with "free-rinsing" in general is required because of the fact that a thin film of cleaner solution usually tenaciously adheres to the metal surface. If any of the cleaner components precipitate when immersed in cold rinses or dips, it becomes another problem in cleaning to remove the film before subsequent plating. Difficulty soluble soaps are the chief malefactors in this connection.

(8) *Alkalinity, pH, and buffer action.*

The optimum alkalinity of a detergent solution expressed in terms of pH depends upon almost all the factors described above as important in metal cleaning. As a rough generalization the following table may be given: (Cleaning of Metal, by R. W. Mitchell Pt. 1 in Metal Cleaning and Finishing, January, 1930):



Depending on the metal to be cleaned, the dirt, and the actual cleaner used, there is an optimum pH at which the greatest efficiency will be obtained. Once this optimum pH has been determined, it should be maintained throughout the life of the cleaner, that is, the solution should be strongly buffered at that pH. The factors contributing to a change in pH are:

(a) Neutralization by acid dirt as by drag-in from acid dips or pickles and presence of acidic materials in dirt such as drawing compounds, soluble oils, stearic acid, soldering flux, etc.

(b) Dilution due to drag out of cleaner or adsorption of cleaner by dirt.

(c) Neutralization due to carbonation.

(9) *Tarnish and corrosion effect.*

This depends to a considerable extent on the pH. Naturally the more reactive metals such as tin, lead, zinc and some of their alloys require a lower pH than, for example, nickel, otherwise both corrosion and tarnish occur. The time of immersion is also important, it being not only necessary that the metal not tarnish or corrode in the interval required for its cleaning but also essential that there be a liberal margin of safety for those cases during commercial production in which the length of immersion may be two or three times as long as necessary.

(10) *Sud-forming properties.*

Sud-formation becomes significant mainly in electric cleaning. Here due to the agitation of the gas, there is a strong tendency for suds to form with the accompanying dire and undesirable results if they form too easily.

(11) *Stability.*

The ingredients of the cleaner should exist together at elevated temperatures for long periods of time without undergoing chemical change else the efficiency of the cleaner is decreased and its life shortened.

(12) *Electrical Conductivity.*

This property need be considered naturally only when the solution is to be used together with electric current. The electrical conductivity should then be high to admit high currents (about 30 to 60 amperes per sq. ft.) at the impressed voltage (usually 6 to 10 volts) which in turn result in a copious evolution of gas for cleaning purposes.

It will be noted in the above tabulation that several of the desirable features may be traced to a single fundamental property with proper modifications. Thus wetting, displacement of oil, and emulsification may be resolved into a study of interfacial tension. Nevertheless, no cleaner will be successful that does not to a great extent possess most of the desiderata outlined above.

Finally, in the analysis of this cleaning problem, the possible ingredients have to be considered. The number of possibilities is very large but only representatives of general classes and certain common ones come within the scope of this investigation. The following list will illustrate the possibilities:

1. Sodium carbonate.
2. Sodium hydroxide.
3. Trisodium phosphate.
4. Sodium metasilicate pentahydrate.
5. Sodium cyanide.
6. Sodium chloride.
7. Sodium sulphate.
8. Sodium borate.
9. Soap.
10. Sulphonated higher alcohols.

Perhaps a word here will not be amiss. This type of material has fairly recently come into use as a detergent, especially in the textile industry. For the purpose considered here, its chief advantages lie in its marked solubility and stability at pH's lower than usual for soaps and the solubility of its alkaline earth and heavy metal compounds under most practical conditions.

METHODS OF TESTING EMPLOYED IN THIS INVESTIGATION

Various procedures have been employed by investigators for evaluating certain detergent properties of alkalies and considerable data are available for many individual salts. I believe

most of this work has been done in connection with laundries. It soon became apparent on study, however, that the results obtained for properties of various individual alkaline salts were not necessarily additive, that is, knowing the properties of individual solutions of certain salts did not imply that one could foretell how those salt solutions would act when mixed together. For this reason, it was decided to make up a cleaner solution, based on experience and a study of the analysis of available commercial cleaners, and to vary the concentration of a single ingredient at a time, studying the properties of the solution after each variation. In this way, the effect of each of the possible ingredients on the properties of the cleaner could be isolated and yet the results be applicable in finally specifying the formula of a cleaner. As an example, these four solutions were used in one part of the investigation of the ingredient sodium metasilicate, the values used being chosen after a careful study of six of the most popular industrial cleaners:

Solution 1: 15 g/l sodium carbonate; 15 g/l trisodium phosphate; 10 g/l sodium hydroxide; 0 sodium metasilicate.

Solution 2: Same as 1 with 5 g/l sodium metasilicate.

Solution 3: Same as 1 with 10 g/l sodium metasilicate.

Solution 4: Same as 1 with 20 g/l sodium metasilicate.

In the following description for the sake of brevity only the general nature of the tests will be given. A more complete and detailed report of this soon will be published in the literature.

(1) *Wetting.*

Drops of the different solutions at 185° F were allowed to spread on a carefully cleaned plane surface of heavy glass and the area thus covered determined by counting the corresponding squares on a sheet of graph paper placed under the glass. The area covered by the drop was a measure of the wetting ability of the solution.

(2) *Displacement of oil from surface.*

A measured amount of pure mineral oil was spread over the walls of a series of carefully cleaned test tubes. Into these tubes were slowly poured the solutions to be tested, heated to 185° F. The tube walls and the amounts of oil on the surfaces were examined at intervals.

(3) *Emulsification.*

Two tests were here used. The procedure in the first was this. Into cylinders, graduated to 100 cc., were put specified amounts of the desired cleaner and of pure mineral oil. The cylinders and contents were heated to 185° F and then shaken in a standard manner. The time necessary for certain volumes of clear solution to form was measured and used as an indication of the emulsification property of the solution used.

In the second test a stalagmometer was used. By means of this instrument one could determine the size of the drops of pure mineral oil issuing from it through a fine orifice into a particular cleaner solution. The relative sizes of the drops issuing into different solutions, heated to 185° F, gave a comparison of the relative values of the interfacial tensions involved, which, as explained above, have an important bearing on emulsification.

(4) *Chemical Activity as a Cleaner.*

Only the saponification ability was here considered as other beneficial activity could be qualitatively foretold from a consideration of the chemistry of the ingredients. As a saponifiable material, the binder in tripoli cake was chosen, made of equal parts of stearic acid and tallow. To a definite amount of cleaner solution heated to 185° F was added a measured amount of binder, the whole shaken for 1/2 minute and allowed to stand at constant temperature for 5 minutes, after which further reaction was retarded by immediate cooling. The solution was at once filtered and titrated with acid and after applying certain corrections, the extent of saponification could be calculated.

(5) *Deflocculation.*

Into cylinders graduated to 100 cc. were put a 100 cc. of cleaner solution and the whole heated to 185° F. A certain amount of inert material or "dirt" was then added, the liquid shaken in a definite manner, and the cylinders then allowed to stand at constant temperature for a specified period. At the end of this time, the concentrations of so-called "dirt" in the supernatant liquid indicated the deflocculating ability of the solution.

(6) *Alkalinity, pH, and buffer action.*

Two types of tests were here applied. In the first a standard amount of cleaner solution was titrated using first phenolphthalein and then methyl orange. The relative amounts of acid

used respectively with these indicators measured whatmight be called the alkalinity useful (i.e. of the proper pH) for cleaning.

In the second test, the pH of the cleaner was determined after adding various percentages of acid or water to it, and the buffering action thus determined.

(7) *Tarnish and Corrosion effect.*

Various metals such as nickel, brass, Britannia, lead-tin alloys, etc., were immersed in the cleaner being studied for definite intervals and then their surfaces examined for tarnish and corrosion. Where action had taken place, the effect on the attacked surface of various dips such as cyanide or acid solutions was observed.

Again for purposes of brevity in this paper, all the tests have not been described but in the discussion of the results which follows, explanatory remarks about hitherto unmentioned tests will be made as necessary. In all this work, tests were repeated more than once, changes in details made, if necessary, and results averaged. The purpose of the tests was as much to determine the trend of any particular influence as it was to obtain specific detailed figures, since in many cases practical factory tests based on the knowledge of these trends were as important as the laboratory tests. To illustrate the type of results obtained, various sets of data, graphically portrayed, are included here and will now be discussed.

DISCUSSION OF RESULTS

Little attempt will be made in this discussion to give complete theoretical explanations of some of the phenomena observed. The reason is that most of the attempted explanations would be too debatable for our present purposes and to accrue sufficient data to settle any one point would probably be a complete and separate investigation in itself.

Sodium Metasilicate.

On Plate 1 are shown graphically some of the properties of sodium metasilicate pentahydrate. Fig. 4 shows curves indicating the volume of emulsion left after given time intervals. The volume is expressed as percent of the total possible volume of emulsion. Naturally, the larger this percentage in a given time or the greater the time to reach a certain percentage, the

better is the stability of the emulsion. From the curves in Fig. 4, it is obvious that at least 10 g. of metasilicate per liter are needed to give any beneficial effect and that even if 20 g. per liter are used the advantage is slight. Fig. 5 shows the length of time for only 25% and 5% emulsion to be left at the various concentrations of metasilicate. The vertical shape of the curve agrees well with the previous statement that sodium metasilicate has some but no great effect on emulsification properties. A further confirmation is shown in Fig. 6 in which are platted the results of the stalagmometer test, expressed as number of drops of oil per unit volume emerging from a given orifice into solutions of different metasilicate concentrations. The literature contains statements to the effect that sodium metasilicate, due to certain colloidal tendencies, improves emulsification. Our results show that this is neglible especially as compared to the effect of very small soap additions (see below).

Fig. 7 shows clearly that metasilicate contributes nothing to the saponification ability of a cleaner, or at least in the presence of the other components of the cleaner.

Figs. 9 and 10 illustrate the buffering qualities of metasilicate on one hand as affected by acid additions, on the other by water additions. From these curves, it is evident that little benefit is derived in the latter case from the addition of metasilicate. In the case of buffering against acid additions, there is an advantage in using sodium metasilicate, in minimum amounts of 10 g. per liter. The pH range buffered appears to be about 12.6 to 12.9. Further information concerning the alkaline features of this compound may be derived from Fig. 11, in which are plotted the equivalents of acid in titrations using methyl orange and phenolphthalein. Since the latter titration indicates roughly the "useful" alkalinity for metal cleaning, the flatness of the curve is a measure of the value of the ingredient. It will be noted that the curve for the methyl orange titration is practically vertical, indicating that almost all of the metasilicate is contributing to the desired alkalinity of the solution. The actual magnitude of the contribution may be judged from the curve of percentage included. The values for this curve are obtained by dividing the acid equivalent in the phenolphthalein titration by the total acid used in the combined titrations.

Figure 12 indicates that the dirt suspension properties of a

cleaner are improved about 50% in increasing the metasilicate concentration from 10 to 40 g. per liter.

In the tests for displacement of oil from the surface, such small differences were found in the use of the various metasilicate concentrations, or in fact in the case of other salts also, that it was decided to discontinue these tests. It seemed that in the combinations of alkalies here considered, this property of oil displacement was always well taken care of.

Similarly, it was found unprofitable to continue measurements on the wetting ability directly. The results were so nearly alike for all solutions that the errors involved might have caused the differences. Furthermore, the stalagmometer indirectly indicated this property.

In the tarnishing tests described above, 20 g. of metasilicate per liter were found to distinctly decrease the tarnishing effect of a cleaner on nickel silver, Britannia, and an alloy of 50% tin and 50% lead.

Trisodium Phosphate

Plate II contains curves for various properties of this component. Figures 13 and 14 show an advantageous effect in emulsification of about the same magnitude as in the case of sodium metasilicate. Figure 14 shows that there is a negligible increase in this slight advantage in using more than 30 g/l of the salt. Figure 15 corroborates the slight beneficial effect, and indicates further that there is no change in interfacial tension below a concentration of 30 g. per liter. In short, the value of the sodium phosphate in improving emulsification may be neglected as in the previous case of sodium metasilicate.

Figure 16 indicates clearly that, contrary to popular notion, in the working pH range of a cleaner, trisodium phosphate has very little buffering action. Figure 17 merely illustrates what is already well known from the chemistry of trisodium phosphate and needs no comment at this stage.

Unexpectedly enough from the above considerations, phosphate so disturbs the saponification equilibrium or due to its slight improvement in emulsification so increases the reactive surface, that in amounts up to about 30 g. per liter the saponification is slightly improved in the cleaner, as shown in Figure 18. A similar improvement is noted in the deflocculating properties—Figure 19.

In tarnishing tests, the addition of phosphates inhibits somewhat the discoloration due to the cleaner in the early stages. After continued exposure, however, in the case of the soft white metals, the phosphate has no beneficial effect. In the case of nickel silver, although the surface appearance is better in the solution with phosphate, the tarnish that is present is more adherent than from the no-phosphate solution.

Summarizing, contrary to popular belief trisodium phosphate is of little use in a cleaner, improving only the saponification and deflocculation and those only to a limited extent. This slight advantage is offset by the tendency of phosphate to increase the tenacity of any tarnish formed on the metal being cleaned. It thus appears to be distinctly inferior to sodium metasilicate in almost every respect. Plate III shows a comparison of certain cleaner properties in the case of the metasilicate and trisodium phosphate. It seems clear from the above discussion that sodium metasilicate should be used to entirely replace the phosphate.

Soap.

Plate IV shows a comparison between three different soaps — a fourth one will be shown on Plate IV-A. Soap A was the commercial Ivory Soap, Soap B was made by mixing together equivalent amounts of oleic acid and triethanolamine, and then adding 5% excess of the latter. Soap C was essentially a sodium resinate.

Figures 23, 24, and 25 show the effect of these soaps on emulsification. Soap A, in amounts that are not critical, stabilizes an emulsion considerably. It is now evident why the effect of metasilicate in this respect was considered negligible. Soap B in small amounts is even more effective than Soap A, but loses somewhat this advantage as its concentration increases. A relatively high concentration of Soap C is needed to obtain note-worthy improvement in emulsification, although its effect over a wider range of oil concentration in water, as indicated by the displacement of the entire curve D from A in Figure 25, as compared to the corresponding separation in Figures 23 and 24.

In the stalagmometer tests — Figures 29, 30 and 31 — all soaps are about equally efficient, and their advantage clearly indicated. In these curves the time in minutes is plotted for

100 drops to leave the pipette under the conditions of test explained above. Naturally, the shorter time indicates the better emulsification properties. It will be noted in Figure 31 that the effect of Soap C is not as great as A or B, confirming previous statements.

Figures 32 and 33 show that either soap also appreciably improves the deflocculating ability of a cleaner.

Plate IV-A shows some of the properties of the fourth soap, which was a sulfonated higher alcohol, essentially sodium lauryl sulphate.

Figure 33a shows that the emulsifying properties of this soap improve as its concentration increases. As before, the improvement is naturally most noticeable upon the first addition of the soap. The degree to which it improves emulsification is at least as good and apparently somewhat better than in the case of the best of the other three soaps mentioned.

Figure 33b confirms the statement concerning improved emulsification with increased concentration, and indicates that after the first addition of soap the improvement is almost directly proportional to the concentration. It is to be noticed from Figure 33a that this improvement persists over the entire range of oil concentration in cleaner.

Figure 33c confirms all the above statements, and indicates the superiority of this soap as far as emulsification is concerned, even over triethanolamine oleate.

In the case of deflocculation, however, as illustrated in Figure 33d, there appears to be no advantage gained by the use of this material.

Actual practical factory tests confirm the advantages in the use of this particular soap. Although its excellent cleansing ability demonstrated on unclean metals is equalled in the use of triethanolamine and oleic acid, its rinsing qualities and the complete absence of any scum or haze on the rinse water is not matched in the case of any other soap tried. This advantage is credited to the relatively great solubility of its alkaline earth compounds and to its stability and solubility at relatively low values of pH.

Sodium Hydroxide.

On Plate V are demonstrated various properties of sodium hydroxide. From the previous experience with soaps, it was

thought unnecessary to continue emulsification experiments for this ingredient and sodium carbonate.

Figure 34 illustrates the expected result that the addition of sodium hydroxide increases the pH of the solution. The interesting points are that 10 to 20 g. per liter are needed to obtain almost the maximum effect, and that the ingredients present exert their greatest buffering influence above a pH of 13.

The solid line in Figure 36 shows the marked effect of caustic saponification, which is largely expected. It should be mentioned that a check on the point corresponding to 20 g/l caustic indicates that the value should be shifted somewhat to the left, thus resulting in a somewhat smoother curve. The maximum still exists, however, and is well known to soap makers.

In Figure 37 the solid line shows a marked improvement in deflocculation on the addition of caustic. Since deflocculation is intimately related to the colloidal chemistry of the solution, the explanation of the action of the hydroxide probably includes the question of stability of the colloid at various values of pH.

From these results, it is evident that caustic is one of the most important additions to a cleaner solution.

Perhaps these few plates already illustrate sufficiently the type of results that were secured. Other salts were studied and these may be considered in the conclusion.

CONCLUSION

It may be well to sum up in conclusion some of the more important results.

1. Emulsification appears to be of major importance and salts possessing this property to a high degree possess also other desirable properties, such as wetting, etc. For this purpose, soap is by far the best. The sulfonated higher alcohols hold forth great promise, and their use at a concentration of about 3 g. per liter is advocated.

2. For saponification ability the use of sodium hydroxide is recommended. Where such a use results in too high a pH, sodium tetraborate should give excellent results.

3. The property of deflocculation is possessed to a relatively high degree by sodium metasilicate, which for other reasons to be mentioned makes a desirable addition to a cleaner.

4. For increasing the pH of the solution, caustic is of course to be used. Where milder cleaners are desired, sodium meta-

silicate may replace some of the caustic. The best buffering action is shown by sodium metasilicate at minimum concentrations of 10 to 20 g. per liter. The presence of this salt is also influential in retarding tarnish.

5. It would appear that in general sodium hydroxide, sodium metasilicate, sodium tetraborate, and soap, constitute an important group of alkalies for detergent purposes. In solutions containing these at appropriate concentrations, sodium carbonate and trisodium phosphate contribute little. In fact, under certain circumstances trisodium phosphate may actually result in a more tenacious tarnish than would otherwise be obtained.

In conclusion, let me express the hope that these experiments have clarified at least somewhat the problem of the cleaning of metals before plating, and that a proper procedure for constructing satisfactory cleaners has been indicated. Using the results obtained in our investigation, on which this report is based, cleaning formulae have been devised and tried on a practical scale in the plant. Although at the present time no absolute answer is as yet possible, the results already obtained are certainly very promising. (Applause)

CHAIRMAN BLUM: At the suggestion of the committee, and with the permission of the other speakers, I am going to call for the paper that was listed as the last paper, on "Solvent Degreasing of Metals", which fits in well with the paper on the "Alkaline Cleaning of Metals." This paper will be presented by F. E. Barron and M. Marean of E. I. du Pont de Nemours & Co., and will be read by Mr. Marean.

A. E. S. BRANCH EXHIBITS

THE METAL INDUSTRY CUP

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This article was written specially for the MONTHLY REVIEW by Dr. L. C. Pan whose present address is 381 Rue Auguste Boppe, Shanghai, China. April 16, 1935.

Estimating Ammonia *in* Brass Plating Baths

By L. C. PAN
U. S. Research Corp.,
Long Island City, N. Y.

THE use of ammonia to improve the color of brass electrodeposits from a cyanide bath is well-known. Hogaboom[1] reported using 1 gallon of strong ammonia water every day in a 2300 gallons installations. While ammonia improves the color of the brass deposit, an overdose of it may also spoil an otherwise good plating bath. Therefore it is advisable that the ammonia content of a brass plating solution be properly regulated.

The regulation of the ammonia content in a brass solution may be carried out in various ways. The common practice has been to add ammonia water as needed according to the appearance of the brass deposit. The amount is dependent entirely on visual observation and personal judgment. But there are a number of factors which make this rule-of-thumb method doubtful: First, the ammonia in the brass solution is not stable, it escapes into the air through evaporation. Secondly, it decomposes at the anode according to one or both of the following reactions:

$$2NH_3 + 3O \longrightarrow 3H_2O + N_2 \qquad (1)$$

$$NH_3 + 4O \longrightarrow HNO_3 + H_2O \qquad (2)$$

Thirdly, the cyanide in solution may also decompose according to the following equation:

$$NaCN + 2H_2O \longrightarrow NaCO_2 + NH_3 \qquad (3)$$

giving sodium formate, $NaCO_2$, and ammonia. The latter reaction incidentally, will explain the experience of many electroplators who have observed that a brass plating bath works better after aging. During aging, some of the cyanide had probably decomposed to form ammonia, which would have a beneficial effect upon the quality of deposit. Finally, the ammonia water in the commercial form may not have the strength as represented by the vendor or manufacturer, because it natur-

ally loses its strength on standing; for example, a bottle of C.P. ammonia water had been purchased sealed and undoubtedly bottled at full strength, i.e. 28 per cent., by the manufacturer. But when the customer opened it and tested, it was only 27 per cent. Without resealing, the bottle was allowed to stand in the original bottle with a glass stopper; after six months it analyzed only 22 per cent.

With all these factors interfering with the use of ammonia in brass plating it is evident that the only reliable way to control is to analyze the brass plating electrolyte to find the amount of ammonia actually present at the moment.

The exact knowledge of the ammonia content of brass plating solution is important for another reason, i.e. ammonia would have a considerable effect upon the accuracy of free cyanide determination by either the Liebig method or by its modifications using an iodide indicator[2].

Since ammonia is a moderately strong alkali, its presence might affect the alkalinity or the pH value of the solution. But Thompson's Work in attempting to control the pH value of the brass solution showed only negative results[3]. Experiments conducted by the author to determine the pH value of brass electrolyte with additions of various amounts of ammonia failed to show any definite relationship between the ammonia content and pH value. It seems that the nearest approach to an accurate control of ammonia content of a brass plating solution is by chemical analysis.

The gravimetric method using chlorplatinic acid is not applicable because of the interference by free cyanide and metal cyanides present. The volumetric method combined with a distillation in presence of a strong alkali may be used not without difficulties, however. (1) The amount of ammonia present in a brass plating electrolyte is very small, i.e., well within one tenth of one per cent. Any small error would materially affect the results of analysis. (2) There are many interfering factors such as decomposition of cyanide which would make results too high. But this method is the best the writer could suggest at present.

The distillation-volumetric method for ammonia consists of distilling a definite volume of brass plating solution in presence of a strong alkali and collecting the distillate in a measured

volume of standard acid and finally titrating the acid with a standard alkali to the neutral point. The difference between the amounts of two standard reagents used is a measured of the ammonia in the brass solution. The detailed procedure of this method follows:

Ten ml. of brass plating solution is measured into a 250 ml. erlenmeyer flask. Add 50 ml. water. Insert a two-hole rubber stopper to the flask with a bent glass tube 40-50 cm. long in one end, a short piece of glass tube in the other, which is enclosed by a piece of rubber tube and a pinch-cock. That end of the long glass tube which protrudes the rubber stopper is blown with a hole on the side. The free end of the long glass tube dips into another 250 ml. flask containing 20 ml. of standard 0.1 N. sulfuric acid from a burette and 40 ml. of water. This flask is set floating in a beaker of cold water.

When the above set-up is ready, added 20 ml. of 6 N. sodium hydroxide solution in the first flask and close the rubber stopper quickly. Then light the Bunsen burner and heat up the contents of the flask to a gentle boiling. Continue to boil until one third of the contents is distilled off and is collected in the second flask. At this time remove the pinch-cock so as to release any back-pressure and remove the burner. The contents of the second flask is again cooled, if necessary, under running water. Add two drops of methyl red indicator, and titrate it with standard 0.1 N. ammonium hydroxide reagent until a neutral (orange) color is obtained. If this end-point is overstept, it could be brought back by adding the standard sulfuric acid reagent from the burette.

From the amounts of the two standard reagents used, the ammonia content of the brass plating solution may be calculated according to the following equations:

$$\text{NH}_3\text{, in. g./L.} = \left[(\text{H}_2\text{SO}_4 \text{ used, in ml.} \times \text{Strength of } \text{H}_2\text{SO}_4) - (\text{NH}_4\text{OH used, in ml.} \times \text{Strength of } \text{NH}_4\text{OH})\right] \times 1.7$$

$$\text{ml. of 28 per cent ammonia per gal.} = \left[(\text{H}_2\text{SO}_4 \text{ used, in ml.} \times \text{Strength of } \text{H}_2\text{SO}_4) - (\text{NH}_4\text{OH used, in ml.} \times \text{Strength of } \text{NH}_4\text{OH})\right] \times 25.5$$

In checking the above method against known solutions, it was found that this method is not free from errors. First, during distillation a small amount of ammonia, i.e. about 2

per cent. of total, is lost. Secondly, when the brass solution is heated, as is necessary in this method, a certain amount of cyanide is decomposed according to equation (3) above and the results became too high by up to 5 per cent. depending on the composition of the brass solution. Fortunately these two errors happen to be in opposite directions, so that they compensate each other. On the whole in the absence of better methods, this method is accurate enough for routing control work.

Using this method, the writer has been able to determine by a series of experiments the optimum ammonia concentration for good brass deposits. It turned out for the ordinary type of bath, such as,

Copper cyanide	4.2 oz./gal.
Zinc cyanide	1.5 oz./gal.
Sodium cyanide	6.7 oz./gal.
Sodium carbonate	4.0 oz./gal.

the optimum ammonia concentration was 0.1 – 0.3 g./L., NH_3, or 1.5 – 4.5 ml. of 28 per cent. ammonia water per gallon.

Appendix

Preparation of Reagents Used in Ammonia Determination

1. Standard 0.1 N. sulfuric acid—Add 2.8 ml. C.P. sulfuric acid (sp.g.1.84) to one litre of water and mix. Calibrate it against C.P. anhydrous sodium carbonate.
2. Standard 0.1 N. ammonium hydroxide—Add 7 ml. C.P. ammonium hydroxide (sp.g. 0.901) to one litre of water and mix. Calibrate it against standard 0.1 N. sulfuric acid (above).
3. Methyl red indicator—Dissolve 0.125 g. methyl red (a dye) in 150 ml. of ethyl alcohol. When all dissolved, add 100 ml. water and mix.
4. 6 N. Sodium hydroxide—Dissolve 125 grams of sodium hydroxide sticks in enough water to make a total volume of 500 ml.

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1. Hogaboom, G.B. "Brass Plating" Souvenir Year Book, the Philadelphia Branch of the Am. Electro-Platers' Soc., P. 58-76, (1929)
2. Pan, L.C. "Analysis of Free Cyanide in Brass Plating Baths" Metal Industry (N.Y.) *30*, 438 (1932).
3. Thompson, M. deKay, "Brass Plating" Metal Cleaning and Finishing, *6*, 449 (1934.)

Multiple Nickel Plating *on* Zinc

Introduction

By E. A. ANDERSON
Chief, Metal Section, Research Division, The New Jersey Zinc Company, Palmerton Pennsylvania.

WITH the ever-increasing demand for heavier and heavier electrodeposits has come a multitude of problems of production. It is often easier to specify a heavy coating than it is to produce it.

There is no question of the need for heavier coatings. The prosperity of the electroplating industry depends upon the satisfaction which the consumer obtains from plated products. The evidence is piling up to indicate that the key to this satisfaction lies in heavy coatings.

In the case of heavily plated zinc, we have come to a cross road. The type of cold nickel solution commonly used at the present time seems to have distinct limitations so far as deposits heavier than .0005″ are concerned. Coatings in the region of .00075″ to .001″ applied from these solutions show a pronounced tendency toward cracking when exposed to the outdoor atmosphere. The penetration of moisture through these cracks result in early development of white zinc salts and the production of an unsightly appearance. We do not wish to imply that such cracking is universal but it does occur with sufficient frequency to warrant serious consideration of other methods of plating.

Since the difficulty with which we are concerned results from lack of ductility in the nickel deposit, the most natural remedy to consider is that of increased temperature of the bath. This as is well known, will decrease polarization and will improve the ductility of the nickel. The system of multiple nickel plating, which forms the subject of this talk, is based on this effect.

There are available a number of cold nickel solutions usable for plating on zinc. These depend for their success upon the repression of the ionization of the nickel by some means or other. As soon as the temperature of the solution is raised, this effect tends to vanish and attack on the zinc by the solution becomes of importance. Possibly, some one may develop a solution in the future from which soft nickel can be deposited directly on zinc. There is none available today with which we are familiar.

It seems necessary then to resort to some system of multiple plating to secure the desired softness of the deposit and at the same time to protect the zinc base from attack during plating. One such system is already in commercial use; that is, the deposition of copper followed by the application of soft nickel. The advantages and disadvantages of this method are familiar to most of you and in any event the development and perfection of the procedure is in good hands.

The system of plating with which we are concerned this evening is that of multiple nickel plating; a system in which an adherent deposit of soft nickel is superimposed upon a thin coating of nickel applied from a cold solution. We have been experimenting with this method for about one year and a half and feel that the results obtained should be of interest to any one plating zinc or zinc die castings.

The system is briefly as follows:

(1) Strike for 5—10 minutes in any suitable cold nickel solution. The following formula is suggested:

Nickel sulphate	15 ounces per gallon
Anhydrous sodium sulphate	15-18 ounces per gallon
Ammonium chloride	2-3 ounces per gallon
Boric Acid	2 ounces per gallon
Temperature	75°-85° F.
pH	4.9-5.4 (electrometric)*
Current density	24-30 Amperes per sq. ft.

*May be increased to as high as 30 ounces per gallon for intricate shapes.

(2) Rinse thoroughly in cold water.

(3) Transfer without drying to the following solution:

Nickel sulphate	20 ounces per gallon
Ammonium chloride	4 ounces per gallon
Boric Acid	2 ounces per gallon
Temperature	105°-115° F.
pH	5.0-5.3 (Electrometric)
Current density	40-80 Amperes per sq. ft.

For convenience in discussing this solution and method, the subject material may be divided in four parts as follows:

Solution Composition
Operating Details
Zinc Contamination
Effect of Sodium Salts

Solution Composition

In the selection of a warm solution for use with zinc, some care is needed. Solutions of lower pH tend to attack the zinc base unless it is of a shape which permits complete covering of all surfaces in the preliminary strike. High pH solutions of certain types are found to produce streaky nonadherent deposits when operated warm and at high current density. In the preliminary work leading up to the development of the procedure under discussion, it was noted that separation of the soft nickel deposits from the strike coating occurred readily with a number of the solutions tried. This was particularly evident with low pH solutions.

It will be noted that the formula for the preferred bath includes ammonium chloride. This, to our mind, is an important essential. The difficulty of peeling and cracking experience in warm high pH solutions seems definitely attributable to the codeposition of nickel and basic nickel salts. This precipitation occurs in a normal nickel bath at a pH of 6.6, a pH readily reached adjacent to the cathode at high current densities. In the course of our experiments we have found that the presence of the ammonium will raise the precipitation pH to the value of 7.6 which is sufficiently high to permit the production of ductile adherent nickel.

Were the ammonium ion to be omitted from this solution, it would be necessary to lower the solution pH to a point sufficiently low to prevent the cathode pH from reaching 6.6. If this were done, serious difficulty would be encountered with attack on the zinc by the solution.

We do not wish to imply that this is the only solution which can be used for the purpose of multiple nickel plating. It was selected, however, on the basis of tests in comparisons with a number of other compositions and seems to fulfill all of the requirements.

Operating Details

In the course of continued work with any plating solution or plating method, the observer will note numerous details which will be of interest and assistance to prospective users of the solution. These we will attempt to give here.

Rinsing—Thorough rinsing is important to prevent dragover of sodium salts from the strike bath into the warm solution.

You have already noted that the formula omits all sodium salts. The reasons for this will be presented later in this talk.

Drying—The parts should never be permitted to dry between the strike coating and the final plating, since peeling will almost inevitably follow. This naturally suggests the use of cold water for rinsing.

Breaking of Current—We have noted a number of times that breaking of the electrical circuit during the final plating operation tends to introduce peeling. Apparently, each time the current is broken, formation of that particular nickel structure ceases and a new layer forms upon reapplication of the current. I have seen as many as 5 separate layers on a single specimen, each peeling from the other, where curiosity has caused us to pull the specimens from the solution that many times.

Minimum Current Density—It is of great importance that the current density in the warm solution be maintained above 40 amperes per square foot. We do not feel that we can ever emphasize this point too much. It must be realized that a sulphate solution of pH 5 is quite corrosive in its effects, particularly when used at elevated temperature. Simple shapes may possibly be handled at current densities somewhat below this limit but the full range of commercial parts will demand the use of at least 40 amperes per square feet of current.

Maximum Current Density—In our laboratory work, we have found no real maximum so far as current density is concerned. Specimens have been plated at current densities as high as 200 amperes per square foot. The solution has low polarization and the deposits do not burn. As a matter of fact, for the ordinary plating set-up it is possible to operate directly from the busbars without controlling the current with rheostats. In commercial practice, it is probable that current densities higher than 80 amperes per square foot will not be feasible for some years to come.

We stress this point of current density because it represents to the plater a convenient method of increasing the weight of coating applied without slowing down his operation or requiring additional tank capacity. For instance, in the normal die casting solutions, a 20 minute plate is usually required to produce a 0.0003″ nickel coating. By the multiple method using a 5 minute strike and operating the warm solution at 70

amperes per square foot, a 0.001" coating can be produced in this same time.

Generator Capacity—In order to take full advantage of the multiple nickel plating method, it is necessary that the generator be of sufficient capacity to supply the required amount of current. This may also require the use of larger busbars. It may seem to the plater that such requirements are imposing an unnecessary expense upon him. The answer lies in the fact that since heavy coatings are coming, there is an economic advantage in being able to plate in the same tanks and with the same floor space that is now available. Even assuming that 0.001" coatings of suitable quality could be produced from the die castings solutions now in use, it takes very little calculation to find out that either three and one-third times as many tanks must be available as now exist or the tanks must be operated three and one-third times as long. By installing generator capacity sufficient to operate the solutions at current densities in the neighborhood of 60-80 amperes per square foot, it will become necessary to change substantially either the time or the tank capacity.

Fitting—In our various tests with the warm solution, we have noted the type of pitting frequently referred to in connection with the low pH solution. There was no difficulty in overcoming this with liberal application of hydrogen peroxide. We would add the warning at this point that sodium perborate should not be used for this purpose because of the action of sodium salts on the type of deposit obtained.

Character of Coating—With a new solution the deposits obtained have a characteristic, uniform, soft, gray color with no indications of burning. The deposits buff to a high luster very readily. The uniformity of coating seems to bear some relation to the very low polarization existing in this solution.

Throwing Power—The throwing power of the bath seems from practical tests to be reasonably good. In fact, it has frequently been noted that on certain shapes black streaks develop in the recesses during the strike platings. When transferred to the warm bath these black streaks clear up and true nickel deposits. The distribution of the coating has not been studied intensively. We have made a few tests on relatively simple shapes which indicate that fairly good distribution has been obtained. This

point needs further study on commercial shapes plated in commercial plants.

Corrosion Tests—Exposure tests on specimens plated by the multiple nickel method have shown that the coating so obtained are at least equal to quality to crack-free deposits obtained from cold solutions.

Solution Maintenance—The warm solution while in operation has a slight tendency to slowly become alkaline. The rate at which this takes place is considerably slower than for the normal cold type of solution. It may be printed out here that adjustment of pH should be made with sulphuric acid and ammonium hydroxide.

Zinc Contamination

Any nickel solution used on zinc will in time become contaminated with zinc. This factor must be recognized and steps taken to minimize it.

While a number of experiments could be and were planned to determine the effect of zinc in solution on the properties of the deposit, it is more important that a determination be made of the actual rate at which zinc can be picked up during operation of the solution.

The worst condition that can be encountered in commercial practice is to have objects such as radiator caps and tail lamp brackets on which only 50 per cent of the exposed surface is plated, the remaining 50 per cent acting as a source of supply of zinc to the solution. Actually very few, if any, commercial coatings have as much as 50 per cent of their area exposed to the action of the plating bath.

In order to simulate this condition, tests were made in which 2″ x 6″ specimens of zinc were plated back to back with only sufficient space between them to permit ready access of the plating solution. A number of sets of these specimens were plated in 3 liters of solution and the solution analyzed periodically for zinc. The following results were obtained:

Number of Specimens	Zinc Content of Solution Grams per liter
Third set	0.22
Tenth set	0.50
Twentieth set	0.50
Thirty-eighth set	0.50

These results show that the zinc pick-up is quite rapid under these conditions but also show that a very definite maximum quantity in solution is reached after which the zinc deposits with the nickel as rapidly as it goes into solution.

Following this test, a series of 76 single specimens, which plated on the entire surface, were plated in this same solution. After 76 specimens had been handled, analysis of the bath showed that the original zinc content of 0.5 gram per liter had been reduced to 0.009 gram per liter.

In order to check these results another similar test was run, this time with a bath containing 0.3 gram per liter of zinc at the start. After the fifth specimen the zinc content had been reduced to 0.25 gram per liter, after the tenth specimen to 0.17 gram per liter and after the fiftieth specimen to 0.008 gram per liter.

Other tests carried out involved the plating of a large number of single specimens in a solution originally zinc-free. These specimens, incidentally, were given a 1″ right angle bend at the lower end to produce a recess. We were unable to reach a value of higher than 0.008 gram per liter of zinc by this method.

When we consider all of the data, we can reach the conclusion that with complicated objects there is danger of the zinc content rising rapidly to some level determined by the shape of the object. With simple shapes, the zinc pick-up is not appreciable. With complicated and simple shapes intermined it should be possible to keep the zinc content of the solution to a consistently low value.

The effect of more than about 0.3 gram per liter of zinc in the warm solution is to brighten the deposit. However, cracking and poor corrosion resistance begin to develop, reaching serious proportions at about 0.6 gram per liter. There should be no difficulty with careful routing of the work in maintaining the zinc content below the critical amount. In our laboratory work, a solution was operated for nearly a year before the zinc content reached even 0.1 gram per liter.

It was of some interest to determine the actual quantity of zinc codeposited with the nickel. For the purpose, two types of specimen were used: one was of zinc cleaned in such a manner as to permit ready removal of the nickel coating while the other was amalgamated copper. Very close checks were obtained between the two types of specimen indicating that the nickel

samples were representative. Specimens were plated from a 2-ounce gold solution of the sulphate type contaminated with 1 gram per liter of zinc. Additional specimens were plated in the warm sulphate-free solution also contaminated with 1 gram per liter of zinc. The nickel coatings were obtained in the high polarization solution contained about 3 per cent of zinc. The coatings prepared in the warm solution contained 0.2 per cent of zinc.

De incification—The removal of zinc from the warm plating solution should be needed only at infrequent intervals if the rotation of work through the solution is carefully watched. For the purpose, we suggest two simple methods. The first of these involves heating of the solution to 140° F., raising the pH to 6.8 with the ammonium hydroxide followed by overnight standing at 105°-115° F. In the morning the solution may be filtered, the pH and the nickel content adjusted and plating started. Tests on the method have shown that of an original zinc content of 1 gram per liter only 0.025 gram per liter remains after treatment.

The second method is even simpler. The pH is lowered with sulphuric acid, and plating carried out at high current density with scrap cathodes. This may be done overnight or over a week-end.

The Effect of Sodium Salts

Throughout this discussion we have called attention to the need for care in preventing contamination of the solution by sodium salts. The reasons for this are as follows:

Even with comparatively small additions of sodium salts, the character of the deposit shows a radical change. We no longer obtain a uniform color over the entire specimen but develop the type of burning at the edges which characterizes the sodium sulphate type of solution. This restricts the maximum usable current density.

Another difficulty is that, with the burning, there develops also a tendency toward cracking which effects to a considerable extent the benefits to be obtained by the use of the multiple nickel method.

These findings are of considerable interest since polarization measurements show that the increased temperature effects the common ion effect resulting from the presence of sodium salts. In other words, at temperatures in the neighborhood of 110° F. the cathode polarization of the warm solution shows no ap-

preciable change with increasing additions of sodium sulphate up to as high as 10-15 ounces per gallon.

We are not at all certain as to the reason for the burning excepting to suggest that changes in solution conductivity in the presence of sodium salts may have some bearing on the matter.

Resume

To sum up what has been said; a method of multiple nickel plating has been presented; details of the operation and of the control necessary have been offered together with discussion of the problems of zinc contamination. This method should appeal to those to whom the problem of depositing heavy coatings will come in the near future. We will be glad at any time to give what assistance we can to any one wishing to use the method.

ASSIST THE DISTANT MEMBER

It has been brought to the attention of this office that members in the Central and Middle West districts are harboring a doubt as to whether sufficient railway certificates will be presented at the Bridgeport Convention to enable them to derive the benefit of the reduced (1 1/3 times one fare) rate to Bridgeport.

This is not due to the fear that the Bridgeport Convention will not be well attended, but that those attending from nearby Branches will be tempted to resort to other means of conveyance, such as automobile, bus, etc.

In consideration of the desire which we all have to see our distant members at the Convention, and to make this the best attended Convention in the annals of A. E. S. history, it is suggested that nearby members patronize the railroads on their journey to Bridgeport, since a certificate obtained with a round trip costing One Dollar will count as much as those turned in by a San Francisco member. If you feel that you can drive your car for 2.327 cents per mile: this being what your round trip fare will cost you; by all means do so. If you would be certain of meeting all of your distant friends leave the bus in the garage and arrive at Bridgeport free from the strain of traffic and secure in the thought that you have done your bit in assisting him to attend.

The above suggestion is humbly submitted by your

Secretary-Treasurer,

E. STEEN THOMPSON

INDUSTRIAL
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WATERBURY, CONN.

Early Silver Plating *in* America

By WILLIAM G. SNOW

THERE has always been some uncertainty just how the process of electro-silverplating was started in this country. Recently additional information bearing on this subject has been located. It is a matter of record that Elkington & Co. of Birmingham, England, secured a patent for electro-silverplating in 1840. In a general way we have also known that this process was being used in the latter part of the 40's in this country and by 1847 the experimenting had reached a stage where Rogers Brothers of Hartford began to produce spoons and forks on a commercial basis. Prior to that not alone Rogers Brothers but several others were experimenting.

Among them were James H. Isaacson, Wm. H. Pratt, as well as Asa and Wm. Rogers, all of Hartford, possibly others. It has always been difficult to decide whether these Hartford experimenters had in any way the benefit of the Elkington process described as an "Improvement in coating or plating certain metals by galvanic current". It now seems as if the Hartford delvers into this new process had some of this information and this feeling is encouraged from the fact that in the Hartford Times in November, 1842, appears this notice signed by Sumner Smith:

GALVANISM

> The subscriber would respectfully announce to the public that he has discovered the art of Gilding, Silvering, etc., by Galvanism; all orders left at the store of Horace Goodwin, 2d, 166 Main street, will be promptly attended to. The superiority of this process consists in the fact, that any quantity of gold or silver can be put on to all kinds of metals, and will stand the test of acids or alkalies; the superiority of the articles thus covered, will be seen at a glance.
>
> *N. B.* Any person wishing information in this beautiful Art, can obtain it of the subscriber for a moderate compensation.
>
> Nov. 1, 1842 *Sumner Smith*

Sumner Smith, born in Brighton, Mass., in 1811 had come to

Hartford in the Thirties and in 1840 was working for Horace Goodwin, jeweler, as a horologist. He eventually married Horace Goodwin's daughter. In his announcement he offered to anyone willing to pay "a moderate compensation" what he knew about "galvanism" which he stated was "the art of Gilding, Silvering", etc. Sumner Smith was more or less active for several years and shortly after he published this advertisement Wm. H. Pratt in 1843 and Horace Goodwin (Smith's father-in-law) in 1844 advertised that they were doing silverplating.

At this time, working with Pratt as a partner was James H. Isaacson under the name of Wm. H. Pratt & Co. who in 1841 had been in business in East Hartford making coin silver spoons under the firm name of Isaacson, Allen & Co. and this same Isaacson together with Asa Rogers are located in 1843 as being in Granby, Connecticut, connected with Wm. B. Cowles & Co. who had for some time been making German silver spoons.

Sumner Smith (who in 1846 was in Directory as U. S. Patent Agent) died in 1847 and it was found when his estate was filed that there is an item indicating that he owed the Franklin Institute in Philadelphia $10.00. The Franklin Institute which was organized about thirty years earlier had been increasing their services to their members as the years passed and for over twenty-five years they had published what was called the "Journal of the Franklin Institute and Mechanics' Register" in which articles taken from English and other foreign publications touched on subjects in which their members would be interested as well as information of a more general character as to what was happening in the United States.

In 1841 and in issues of the "Journal" in the years immediately following they published a number of articles about the Elkington inventions — and there were several. Inasmuch as Sumner Smith owed the Institute $10.00 when he died, without doubt he had been in close personal touch with what the Institute was doing and probably received the "Journal" as issued. It is therefore a reasonable conclusion that his advertisement in which he offered to sell information regarding "galvanism" was inspired by information that he secured from the Franklin Institute "Journal" which he was probably receiving.

While it has already been shown that a number of people were evidently experimenting with this new process, likely on the in-

formation that Sumner Smith furnished, none of them seemed to have gone very far beyond the laboratory or "job" stage, not realizing the commercial possibilities of the new art except in the case of the Rogers brothers, William and Asa, and Isaacson — they had vision and imagination.

We have already referred to Asa Rogers and Isaacson going to Granby. Whitfield Cowles of Granby graduated from Yale College and in 1794 he was ordained as pastor in Granby in the Turkey Hills district. In 1800 he built for himself a large residence on land which he owned. He continued as a pastor until 1808 when some dissatisfaction arose between the Rev. Cowles and his parishioners and he resigned. About that time or possibly earlier he had added to his regular duties as minister and farmer and became a manufacturer in a small way making wire and wire products including cards for carding wool and other fabrics. He had been a peppermint distiller for many years and was credited with making the first cotton cloth in that vicinity. As early as 1812 Cowles was running a wire company buying the rods from Charles Sigourney & Co., Hartford, which were drawn down to the small wire wanted. A few years later Charles W. Mills made a contract to work with him and later still G. Arthur Griswold worked with Cowles and they were operating as Cowles, Griswold & Mills. Mills left to make cards in Hartford and the firm name was changed to Cowles & Griswold. Later Griswold left and about 1832 Cowles took in his sons under the name of Whitfield Cowles & Sons. At the time his sons came with him or shortly after they had a shop on the banks of the Farmington River just below what is now known as the "Spoonville" bridge and they were undoubtedly on the lookout for anything else that they could produce at their shop.

Whitfield Cowles died in 1840 and one (or more) of his sons continued the business under the name of Wm. B. Cowles & Co. Some time, just when cannot yet be determined, they added to their activities the making of German silver spoons, probably in the late 30's or early 40's, and just before the time that Asa Rogers and James H. Isaacson are recorded as being actively connected with the Cowles industry in Granby. While they were making German silver spoons no silverplating was done before Rogers and Isaacson joined Cowles in 1843.

Evidently Rogers and Isaacson had gone far enough with their experiments in Hartford to realize that the great field for the use of this new process was in making silverplated spoons and forks and that it would be of considerable advantage to handle this new business in connection with a maker of the German silver blanks. Records indicate by books and papers recently located in the old Cowles mansion that they really did manufacture and market silverplated spoons and forks at that time and in 1844 their business had been far enough perfected so that a larger production and a better plan of organization to manufacture was desirable.

They continued to expand their business and that they were selling goods in considerable quantities direct to hotels, steamboats, as well as to dealers for family use, is shown by letters in evidence written in 1847 by Wm. B. Cowles when out selling the line after Rogers and Isaacson had left. He wrote the factory and stated he had an order from the Geneva Hotel in Rochester for spoons likely because Mr. Seeley the proprietor had used the Cowles goods "on his table for three years which gives him confidence in our work." He also secured an order on the Lake steamboat "Nile" from Buffalo because they had been using Cowles spoons on their tables for three years. These indirect testimonials indicate that Cowles was putting out, under the supervision of Rogers and Isaacson, silverplated spoons in 1844.

By 1845 their ideas as to the proper organization had crystalized to a point where Wm. B. Cowles, Granby; John D. Johnson, Waterbury; James H. Isaacson, Hartford and Asa Rogers, Hartford, organized the Cowles Mfg. Co. and were legally incorporated under the laws of the State "for the purpose of manufacturing German and silverplated spoons, forks, butter knives, or any other articles in the same line made from German silver and other metals." Asa Rogers was secretary of the company. That they made considerable quantities of this product is shown by some of the books of the Cowles Mfg. Co. still in existence and although the general public were not yet exactly "sold" on the new idea they were making progress.

During this time Wm. Rogers with his brother Simeon was maintaining a jewelry and silversmith's shop in Hartford at 4 State Street, William having left his partner Joseph Church

(Church & Rogers) in 1836. Prior to that date William as well as Asa had been making spoons of coin silver starting about 1825 and early in 1846 Wm. Rogers was advertising that he was selling the silverplated spoons made by Cowles Mfg. Co. and the New York Commercial at that time published a four-inch write-up headed "Silver and Not Silver" regarding the wonderful electro-silverplated spoons the Cowles Mfg. Co. were producing.

Up to this time while it will be seen William as well as Asa and Isaacson were evidently responsible for the production of quite a quantity of spoons and forks under the Cowles name nothing had appeared with the Rogers mark.

In the Fall of 1846 the Rogers' and Isaacson evidently were satisfied that their plans for manufacturing these goods were far enough perfected so that they could safely put out this merchandise in a large volume carrying the Rogers name. As William and Asa had been making coin silver stamped with their name for many years and undoubtedly had built up a valuable reputation as makers of quality products they did not in any way wish to injure their reputation by sponsoring silverplate until they were sure the product was a good one.

In the Fall of 1846 the Cowles Mfg. Co., as far as the Rogers' and Isaacson were concerned, disbanded, the Rogers devoting their entire time to the Hartford business, using their State Street basement for silverplating the Issaacson going to New York where he had a job plating establishment on Center Street for over thirty years. He was born in Haverhill, Mass., in 1812 of native parents, and died in 1881 in Elizabeth, New Jersey, where he was working for the Singer Mfg. Co.

The Cowles Mfg. Co., due to financial difficulty, had only indifferent success from that time and finally discontinued the spoon business. The locality to this day is known as "Spoonville" although located in the town of East Granby.

Most of us know the career of the Rogers brothers — William, Asa and Simeon, whose ancestor James Rogers settled in New London in 1635. As already stated, from the basement at 4 State Street they worked producing their Rogers Brothers silverplate. By the summer of 1848 more room was necessary and they moved their plating shop to what was then called the "old jail" building in Hartford, corner Trumbull and Pearl Streets. The Hartford Courant of December 12, 1848 had a long article the result of a

visit of "A Man About Town" to the Rogers brothers work shop on the third floor of the "old jail" building. He relates what he saw and he describes the "Art of Silver Plate."

Further expansion was found necessary and in 1853 a four-story brick building was erected especially for their needs in producing both flat and hollowware in silver plate. At this time the Rogers Bros. Mfg. Co. had taken over the old Rogers Brothers business which was consummated in August. This new building was at the corner of Trumbull and High Streets and later was used by the Jewel Belting Co. and was only demolished about ten years ago, just prior to the Telephone Building being erected.

Not alone did the three Rogers brothers, William, Asa and Simeon (Simeon long a partner in Wm. Rogers & Co.) take part in the organizing of the Rogers Brothers in 1847 but they were also interested in the formation of several other concerns in which their experiments and activities played a large part. There was Rogers & Brother, organized in Waterbury in 1858; Rogers Smith & Co., organized in 1856 and Wm. Rogers Mfg. Co., organized in 1865 in Hartford. All of these concerns in which the Rogers were interested and were early producers of silverplate are now a part of the International Silver Co. and are producing the following trademarked lines: "1847 Rogers Bros.", "(Star) Rogers & Bro.", "Wm. Rogers Mfg. Co.", "Wm. Rogers & Son", "(Anchor) Rogers (Anchor)", "(Eagle) Wm. Rogers (Star)", and others. All three brothers, when they died in the Seventies, were connected with the Meriden Britannia Co., giving expert supervision to the 1847 Rogers Bros. line of silverplated spoons, forks, etc.

The Cowles works in 1843-1846 in Spoonville (Granby) were a veritable nursery or training school for workers in the new process of silver plating as well as the making of the German silver blanks for plating. Scores of men who had previously had some experience in the making of coin silver spoons as well as many young men from the farm were employed there. After the Cowles business began to shrink, probably partly the result of the leaving of the Rogers brothers and Isaacson, some of the employees who had previously worked in Hartford and others who were learning in Granby drifted to that important center — Hartford. Many of them immediately worked with the Rogers Brothers on State Street; some made other connections.

There were the Sperry brothers, Egbert W., Albert A., and Wm. W. Sperry and Alfred W. (a son of Egbert W.) who were associated off and on with the Rogers, later lending their experience picked up in Granby or Hartford to other spoon makers either as employees or partners. Practically all of the concerns that they were associated with after leaving Rogers in Hartford are now a part of the International Silver Company.

There was O. D. Mead working for Cowles while Rogers and Isaacson were there — 1845-1846 — then going to Hartford in 1847 working with them at the State Street basement for a year or two, then running a plating shop of his own for a short time, finally going to Philadelphia, where he was in business for about twenty-five years.

The Foxes, Andrew W. and Horace, who before and after their Granby association, were silversmiths in Hartford. In 1846, Marshall Forbes, then about sixteen years old, was learning how to plate and burnish silverware in Granby. A few years later he left, going to Wallingford where he worked for Samuel Simpson for a time in the same line. By 1854 he was located in Meriden working in the plating room of the Meriden Britannia Co. A short time later he was in charge of that important part of the company's work at one hundred dollars a month, and he continued as a superintendent of the hollow-ware plating room until he died.

There were many others who had their first instructions how to plate under the supervision of Asa Rogers and Isaacson — the list is too long to include in this record. The Cowles plant in Granby was undoubtedly the first place where the experimenting that had been going on in Hartford was put to practical work and enable the producer to supply spoons and forks in a standard, uniform way.

While this activity and interest was shown by Hartford residents in early silverplating, the Meriden Britannia Co., which was organized in Meriden, December, 1852 to manufacture Britannia and pewter goods, also included in their line very shortly plated ware, especially spoons and forks. At the start there was a man by the name of J. H. Martin in Wallingford who did plating for the Meriden Britannia Co. who likely got his knowledge of the new art from the Hartford crowd.

By the middle of 1853 the Meriden Britannia Co. began doing their own plating and their first shop to do this work was located on Hanover Street on the north side just west of the corner of South Colony Street. Not alone the Meriden Britannia Co. but also Rogers Brothers in Hartford in those days used silver coin in lieu of anodes. This came about naturally as it was the practice of the silversmiths in those days in making spoons or forks or other pieces, to use silver coin as a basis. This coin they either picked up in circulation or bought from the banks, often paying a premium.

By the latter part of 1853 the Meriden Britannia Co. had arrived at the decision that the use of coin which was only .900 fine was not as economical as to buy pure silver which they then began to purchase from Platt & Brother (Handy & Harmon successor) 4 Liberty Place, New York at $1.50 an ounce. Many of the smaller platers, however, continued the use of coin for a considerable period. In fact as late as the 70's it is known that "coin" was being used for that purpose in some of the smaller factories.

In further reference to the Elkington patents it can be stated that G. R. Elkington of Birmingham, England, was also inventor and patentee for electro deposition of silver in 1838 and that he had secured a patent "for a gilding process by emersion" in 1836. In 1840, he with his cousin, under the name of G. R. & Henry Elkington, received a patent for a more complete process. Originally the Messrs. Elkington, not being manufacturers themselves, planned to permit the use of their process to the trade and grant licenses for their privileges to contemplated manufacturers. They were, however, so unsuccessful in selling this permit that they decided to go into the manufacturing of electro plated goods themselves. This idea of licensing manufacturers to operate under their patents not alone was tried out abroad with indifferent success but one of the Elkingtons is reported to have come to this country in the early Forties endeavoring to see if some possible user could be interested. There is no record that the Elkingtons secured a patent in the United States and there is nothing to show they made any progress toward issuing a permit to any manufacturer here. Around thirty-five years ago the writer ran across in New York a man by the name of Elkington from Birmingham, England, who stated he was a nephew of the Elkington

who originated silverplate. His uncle, so he said, was unable to make any satisfactory arrangement with any American manufacturer to use his process. This was approximately 1841. Shortly after this visit here silverplating with a galvanic battery began to be talked about and a year or two later, as we know, goods of this description were turned out in Granby or Hartford.

In taking this up with Elkington & Co. of Birmingham who are still in business, they recently stated that one of the family, Gerard B. Elkington, came to New York about thirty or thirty-five years ago in the interest of a steel concern with which he was connected and he was probably the person referred to as being in New York around 1900 who described himself as a nephew of Elkington, the patentee.

It will be seen, therefore, that it is unlikely there was any direct connection between the Elkington experiments in England with what was going on later in Hartford except through the Franklin Institute Journal which gave a description of the Elkington process and might have been used as a basis for the Hartford men.

It would seem to indicate that the predecessors of the International Silver Co. were among the earliest producers of commercial silverplate and that they should be given reasonable credit for its early development in this country.

TERCENTENARY CELEBRATION OF CONNECTICUT

It is peculiarly fortunate that this convention is being held in Bridgeport during the tercentenary celebration of Connecticut. Thousands of people will go to Connecticut to view her beautiful scenery, her great manufacturing industries, her educational institutions and her commercial development. These visitors will assure the 23rd Annual Electro-Platers' Convention of the largest number of attendants and guests in the history of the organization.

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Principles of Chemistry

For ELECTROPLATERS

DR. WILLIAM BLUM

LESSON VI. ACIDS, BASES AND SALTS

I—Properties:

A—*Acids.* Acids are chemical compounds that contain hydrogen that can be replaced by metals to form salts. Most acids have a sour taste. When dissolved in water they are dissociated to form hydrogen ions (H^+). The extent of this dissociation indicates the *strength* of the acids. Sulphuric, hydrochloric and nitric acids are "strong" acids; acetic and citric acid are fairly weak, and boric acid is very weak. Many acids are formed by dissolving oxides of non-metals in water. These oxides are called "acid anhydrides". SO_3 is sulphuric anhydride.

$$SO_3+H_2O=H_2SO_4$$

CrO_3 is strictly speaking "chromic anhydride" though commonly called chromic acid.

$$CrO_3+H_2O=H_2CrO_4 \text{ (chromic acid)}$$

B—*Bases.* Bases are hydroxides (or oxides) of metals, which can combine with acids to form salts. Strong bases are called "alkalis". Those that are soluble in water produce "alkaline" solutions, that feel "slippery". These solutions contain "hydroxyl" ions (OH^-) formed by dissociation.

$$NaOH \leftrightarrows Na^+ + OH^-$$

Sodium hydroxide — Sodium ion — hydroxyl ion

C—*Salts.* (1) Salts are compounds formed by

(a) Dissolving a metal in an acid.

$$Zn+H_2SO_4=ZnSO_4+H_2$$

Zinc+Sulphuric acid=Zinc sulphate+Hydrogen

or (b) neutralizing an acid with a base.

$$NaOH + HCl = NaCl + H_2O$$

sodium hydroxide+hydrochloric acid=sodium chloride+water

When dissolved in water, salts are dissociated into positively charged metal ions (cations) and negatively charged "acidic" ions (anions).

$$NiSO_4 \leftrightarrows Ni^{++} + SO_4^{--}$$

Nickel sulphate — Nickel ion — Sulphate ion

(2) *Names of Salts.* Salts containing only two elements, have names ending in "ide", such as chloride and sulphide.

Salts containing three or more elements (including oxygen), derive their names from the acids, as follows:

SUFFIXES

Acid	*Example*		*Salt*	*Example*	
	Name	*Formula*		*Name*	*Formula*
ous	sulphurous	H_2SO_3	ite	sodium sulphite	Na_2SO_3
ic	sulphuric	H_2SO_4	ate	sodium sulphate	Na_2SO_4

(3) *Formulas of Salts.* The formula of a metal salt may be derived from that of the acid and the valence of the metal.

What is the formula of potassium sulphate? Sulphuric acid is H_2SO_4 and the valence of potassium is 1, therefore one atom of potassium (K) will replace one of hydrogen, and the formula will be K_2SO_4.

(4) *Types of Salts* (Acid and basic salts). An *acid salt* is formed by replacing only part of the replaceable hydrogen of the acid with a metal, for example sodium acid sulphate, $NaHSO_4$ (niter cake) represents sulphuric acid that has been only half neutralized with sodium hydroxide. A *basic salt* is formed by neutralizing only part of the hydroxyl of the base with an acid, for example, basic copper carbonate is $CuCO_3.Cu(OH)_2$, that is half copper carbonate and half hydroxide.

II—**Normal Solutions:**

A normal solution of an acid, base or salt, contains in one liter of solution, one "equivalent" of that compound in grams. An "equivalent weight" is the weight of the compound corresponding to one atom of hydrogen, or to one valence. Equal volumes of normal solutions are equivalent to each other. 10 ml of $\underline{N}$ HCl will exactly neutralize 10 ml of $\underline{N}$ NaOH.

Examples:

(1) Hydrochloric acid is HCl. Its molecular weight is 1+35=36. It contains one replaceable hydrogen atom. Hence its equivalent weight is also 36, and a normal solution contains 36 g/l of HCl.

(2) Sulphuric acid is H_2SO_4, and its molecular weight is 2+32+64=98. It contains two replaceable hydrogen atoms,

hence its equivalent weight is 98/2=49, and a normal solution of sulphuric acid contains 49 g/l of H_2SO_4.

(3) Sodium hydroxide, NaOH, has a molecular weight of 23+1+16=40. It contains one OH group, which is equivalent to one H, (for example water=HOH). Hence the equivalent weight of sodium hydroxide is also 40.

(4) Sodium chloride, NaCl, has a molecular weight of 23+35=58. It contains one Na atom, which has a valence of +I, hence its equivalent weight is also 58.

(5) Copper sulphate (crystallized) has the formula $CuSO_4.5H_2O$. Its molecular weight is 64+32+64+90=250. Copper (in cupric salts) has a valence of +II, hence the equivalent weight is 250/2=125, and a normal solution contains 125 g/l of $CuSO_4.5H_2O$.

PROBLEMS

1—In making zinc chloride flux by "cutting down" zinc with hydrochloric acid, the equation is

$$Zn+2HCl=ZnCl_2+H_2$$

Suppose 10 lbs. of zinc is to be dissolved:

(a) What weight of 20% hydrochloric acid will be required?

(b) If the solution is finally diluted to 2 gallons, how many oz/gal of $ZnCl_2$ will the solution contain?

2—In the following table fill in the names and formulas of the salts:

Acid		*Metal*			*Salt*	
Name	*Formula*	*Name*	*Symbol*	*Valence*	*Name*	*Formala*
Hydrochloric	HCl	Nickel	Ni	+II		
"	"	Aluminum	Al	+III		
Sulphuric	H_2SO_4	Lead	Pb	+II		
"	"	Chromium	Cr	+III		
Phosphoric	H_3PO_4	Sodium	Na	+I		
"	"	Calcium	Ca	+II		
"	"	Aluminum	Al	+III		
Carbonic	H_2CO_3	Sodium	Na	+I		
"	"	Calcium	Ca	+II		

3—If 10 ml of a sulphuric acid pickle required 20 ml of $\frac{N}{2}$ sodium hydroxide solution to neutralize it:

(a) What normality is the sulphuric acid?

(b) How many g/l of H_2SO_4 does it contain?

(c) How many oz/gal of H_2SO_4 does it contain?

Amorphous Conditions *on* Polished Surfaces *of* Metal

GEORGE B. HOGABOOM

IN the discussion of the paper on "Ductility and Adhesion of Nickel Deposits" that F. P. Romanoff presented at the Detroit A. E. S. Convention, 1934, Mr. Walter Meyer stated: "There is no real proof that the amorphous condition (of polished meta' surfaces) does exist.....I believe that is something recent, Mr. Hogaboom, and the question of talking about amorphous metals does not seem quite right in the viewpoint of metallurgy." (MONTHLY REVIEW, April, 1935, pp. 19-20.)

Mr. Meyer overlooked the research work of Professor G. P. Thomson (Phil. Mag. 1934) and that of Finch, Quarrell and Roebuck (Proc. Roy. Soc. 1934) which was available at the time of his statement regarding "the latest work in research in metallurgy." The following excerpts from papers presented at the meeting of the Faraday Society in London, England, March 29-30, 1935, are offered in evidence that the amorphous condition of the surface of polished metals does exist and that it was perfectly correct to talk about this in the discussion at that time.

THE STRUCTURE OF METALLIC COATINGS, FILMS AND SURFACES

Cecil H. Desch, D.Sc., F.R.S.

"Beilby in a series of papers from 1903 onwards, observing the process of polishing, both on metals and on non-metallic solids, came to the conclusion that the action of the polishing process was to cause the surface layer to flow like a liquid, this flowed layer then rapidly congealing without crystallizing, so that the surface of the polished substance was covered by a thin layer of an amorphous, or as he preferred to call it, 'vitreous' modification, chemically identical with the underlying solid, but devoid of crystal structure."...."It is a matter of great regret that Sir George Beilby, who was keenly interested in the work of the Faraday Society, did not live to see his experimental work vindicated by evidence of an entirely new kind. It may now be accepted as a fact that the surface of a polished metal is

of such a fine structure as to be incapable of giving a crystalline structure with electron beams."

THE THICKNESS OF THE AMORPHOUS LAYER ON POLISHED METALS

H. G. Hopkins, A.R.C.S., B.SC.

After reviewing the different theories of the surface condition of polished metals the author states: "Finally the work of Finch, Quarrell and Roebuck (Proc. Roy. Soc. 1934, A, **145**, 676) indicates that the amorphous layer is present in the case of polished metals surfaces. It will be seen from the foregoing that there is definite evidence that the amorphous layer exists on polished metal surfaces. Other explanations do not appear to fit the experimental results so well. The reasons for rejecting other interpretations have recently been discussed by Prof. G. P. Thomson (Phil. Mag. 1934, **18**, 640). *Thus it may be concluded that the Beilby layer exists on polished metal surfaces.*"

CONTRIBUTION TO THE EXPERIMENTAL STUDY OF THE INFLUENCE OF THE SUPPORT OR CATHODE ON THE STRUCTURE OF ELECTROLYTIC DEPOSITS OBTAINED IN AQUEOUS SOLUTIONS

Albert M. Portevin and Michel Cymboliste

"It has been known since the work of Osmond (Osmond and Cartand, Les enseignements scientifiques du polissage. Rev. gen. Sci. 1905, 16.) that polishing creates on the surface of a metal a hardened skin which Beilby likened to an amorphous state, which must be removed by chemical attack if one desires to observe the true crystalline structure of the metal. Hothersall (A. W. Hothersall "The Adhesion of Electrodeposited Nickel to Brass", J. Electrodepositors Technical Society, 1932, **7**, 115) has proved its influence in his study upon the adherence of deposits on brass; here again, it is necessary to dissolve (chemically, by acid, or electrolytically) this amorphous skin in order to maintain the reticular orientation of the base metal in the electrodeposit."

Incidentally it may be mentioned that in this paper there are several excellent micrographs of the structure of the basis metal being reproduced in the nickel deposits. This concurs with my discussion of Romanoff's paper.

THE STRUCTURE OF POLISHED METAL SURFACES

C. S. Lees, B.A.

In the "Summary" this author states: "Polished surfaces of copper and gold have been etched electrolytically and photographed by electron diffraction. The Beilby layer has been found to be separated from the non-oriented poly-crystalline interior of the metal, by a layer of oriented crystals; the thicknesses of the two layers have been found. The orientation appears to be due to deformation of the crystals by compression. *It is shown that the actual surface cannot consist of crystal faces.*

At a recent meeting of the Bridgeport Branch A. E. S., Mr. Meyer continued this discussion and showed some micrographs, which unfortunately were not of the etched structure of the metal. He may obtain results from which more definite conclusions can be drawn if he will follow the suggestions for determining the structure of polished surfaces made by G. I. Finch, A. G. Quarrell, and H. Wilman in their paper on "Electron Diffraction and Surface Structure" Trans. Faraday Society, 1935.

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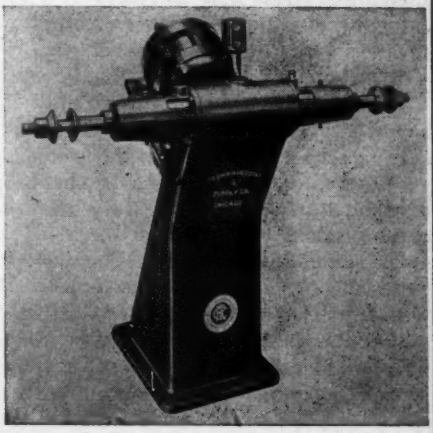

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The Abstract Section

T F. SLATTERY, *Chairman, Program and Educational Committee*

Economic use of Electroplated Domestic Materials (Devrsenersparniss durch Verwending veredeiter heimscher Werkstoffe). *Metallwaren Industrie & Galvano Technik*, Vol. 32, July 15, 1934, pages 307-319. Discusses from economical viewpoint the substitution of Cu and Cu alloys by electroplated Fe and steel objects. Considers galvanizing, Cd plating, Pb wiping, Ni and Cu plating, and non metallic coatings whereby special attention is paid to the danger of corrosion. The use of Al in place of Cu and its alloys is discussed and electroplating and oxidation of Al is dealt with. *M. A.* 4, p. 168, 1935. E. F.

New Method of Surface Inspection (Eine Neue Methode der Oberflachpmfung) F. BEUNIGSON. *Die Metallborze*, Vol. 24, June 23, 1934, p. 793—An optical method is described, designed for inspection of welded and riveted joints, polished and electrolytically coated surfaces, sheet and tube surfaces by comparison with a standard specimen. Four typical photographs which show simultaneously in the visual field of a microscope the standard and test metallic surfaces are presented. The magnification ranges between 30 and 70. *M. A.* 4, p. 159, 1935. E. F.

The following four abstracts are from four additional papers of the discussion held by the Faraday Society on "The Structure of Metallic Coatings, Films and Surfaces". These Sketches, with the twenty published in the May Review complete the abstracting of all papers presented at this Symposium.

7. **Molecular Layers of Fatty Substances on Metals,** by J. J. TRILLAT and H. MOTZ—Electron diffraction experiments indicated that almost all metal films prepared have a thin layer of "oil" on them of one or two molecules thick. It is only through extreme precautions that films without this organic layer may be obtained. With most organic substances, adsorbed by metal surfaces, the molecules are oriented, and arranged in a regular manner.

14. **The Effects of Film Formation on the Structure of Electrodeposited Metallic Coatings,** by E. LIEBREICH—The author believes that many electrolytic phenomena can be traced to an unusually high polarization brought about by the existence of an oxide film on the cathode from which metal is produced, by its reduction by hydrogen atoms. In this manner he explains chromium deposition from the chromic acid bath as a reduction of a film of chromous-chromic oxides by discharged hydrogen.

Chemical and Physical Properties of Electrolytically Deposited Metals in Relation to Their Structure, by Prof. M. SCHLOTTER—It is shown that cathode polarization may be influenced by the anion of the salt. A rule is given that the polarization is related to the size of the anion. The greater the polarization the finer the crystal. Anions may exist in the coherent cathodic deposits. This is shown with the results on copper and silver deposited from iodide solutions.

On "Somatoid" Elements of Structure in Electrolytic Metal Deposits, by V. KOHLSCHUTTER—The paper is a general one on a proposed investigation of obtaining a more detailed theory of the structure of electrolytic metals from a study of the conditions of formation of macroscopic somatoids (units of structure). For example, it is known that uniformly rough deposits or films can be obtained, and from a study of such phenomenon the author hopes to be able to unravel just why a definite structure is exhibited by electrolytic deposits.

Modern Development in Metal Cleaning, H. LEWIS, *Mechanical World and Engineering Record*, Vol. 96, Oct. 19, 1934, page 361, Oct. 26, 1934, page 390—Covers removal of grease and scale from metal surfaces. Grease can be removed by two main processes, either by aqueous detergents or organic solvents. Recent researches on this subject are discussed. Scale is removed by immersion in acid, usually H_2SO_4 and H cl. The application of a 10% H_3PO_4 solution at 80° C gives Fe a bluish-grey color, due to a film of ferro-ferric phosphate, which is an excellent foundation for paint, and also a good rust preventative. Research on pickling has resulted in the development of inhibitors, such as aniline and quinnoline. Mechanism of the action of inhibitors is considered. In conclusion electro-cleaners, alkaline for degreasing, and acid for scale removal are discussed. *M. A.* **4**, p. 155, 1935. Kz.

Silver Plating to Specifications. C. B. F. YOUNG and S. C. TAORMINA. *Metal Industry* (New York) May 1935, p. 165—It is found necessary to have similar shaped and sized articles plated at a given time to obtain reasonably close agreement in the weight of deposit per given area. With much variation in shape and size, weight differences of nearly 100% were found. Under proper conditions, a flat test piece may be used as a pilot to determine the proper current when areas are difficult to compute. Solution control, work distribution, and clean connections are emphasized.

C. T. THOMAS.

On the Regulation of Bath Solution (Oxalic Acid Aqueous Solution) **for Electrolytic Oxidation of Aluminum.** AKIRA MIYATA and MOTOYUKI KAKEI. Abstracts from *Rikwagaku-Kenkyn-Jo Iho*, Vol. 13, No. 11, Nov. 1934, p. 75-76 in Japanese—The authors studied the restoration of deteriorated oxalic acid baths used for the anodic oxidation of aluminum and have attempted a generalization concerning the restoration of such solutions. Oxalic acid was added in gradually increasing amounts to an old solution and the time voltage curve determined in each case at 25° C and 10 A/cm², until the original conditions were restored. On the basis of such data empirical equations were drawn up for calculating the amount of oxalic acid needed for restoration. Authors state that in previous report (reference not given) it was shown that the deterioration of a used solution can be represented by the difference (x-y) of the concentration of Ca O4 (x) and H″ (y) determined by titration of the solution. Representing the difference (x-y) as "p" and the concentration of H′ in a replenished solution, by "W" the authors have formulated the following empirical equation for a 2 per cent solution:—

W—2.0—0.361 p—0.546 P^2—0.08707 p^3 Corresponding equations for 3% and 4% solutions are:—

W—3.0—0.823 p+0.784 p^2—0.1187 p^3

W—4.0—0.556 p+0.718 p^2—0.1146 p^3

In using the equation "p" i.e., (x-y) is determined by titration of the used solution and the equation is solved for "w". Then, W-Y = the amount of oxalic acid to be added. All quantities (x-y and w) are expressed in g. oxalic acid/100 Cu^3. *M. A.* **4**, p. 158, 1935. HSR

Tarnishing of Silver and its Prevention. E. RAUB, *Mitterlunger des Forschungsinstitutes und Probierants für Edelmetalle.* Vol. 8, Sept. 1934, p. 61; Oct.—Nov. 1934, p. 77; Jan. — Feb. 1935, p. 105 — The various forms of corrosion and rapid tests to determine resistance of silver are described. The conclusion is that at present no silver yet exists which is practically tarnish proof, and the chances that such an alloy may be found are not very promising. For this reason, the surface of silver articles is at present made resistant to tarnishing sulphur compounds by coating. Of the many methods proposed, three have found practical application: (1) coating with a transparent lacquer, (2) plating with tarnish proof metal, (chromium, rhodium) (3) passivation by forming a covering layer, (Finckh process). The latter D R P 572324, (not fully described) uses the chromic acid anion for producing a film which in addition to being tarnish resisting, has a fairly good mechanical resistance. *M. A.* **5**, p. 210, 1935. H.A.

Improved Coating Applied to Wire by Electrogalvanizing Steel, Vol. 95, Dec. 24, 1934, page 22—Describes the Bethanizing process used at Maryland plant of the Bethlehem Steel Company. Bright steel wire, after passing through a lead annealing bath is cleaned electrolytically first:—fused sodium hydroxide and then in acid. Zinc, is deposited in lead lined electrolytic cells 55 ft. in length and wide enough to accommodate eight wires. Zinc strip anodes extending the entire length, divide the cells into compartments through each of which a single wire is drawn. Electrolyte is pure zinc sulphate prepared chemically direct from roasted ore. Current density 700—1400 amperes per sq. ft. is used. It is claimed that the coating which may be any thickness desired, is so ductile and adherent that it will not crack, flake, or chip off under severe distortion. *M. A.* **5**, p. 196, 1935. M. S.

OBITUARY

It is with deep regret that we report the death of J. H. Hall a past president of Chicago Branch.

Although he has not been active in the past few years Mr. Hall was a tower of strength and support to Chicago Branch at its inception. He was employed by the F. H. Noble Co. plating novelties for many years but for the past two years has been seriously ill. He was sixty-three years of age and was born in Peru, South America. He died May 4th. Burial May 7th at Oak Woods Cemetery. On behalf of the membership and particularly Chicago Branch we convey our sincerest sympathy to the family of the deceased in their time of sorrow.

J. W. HANLON

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BRIDGEPORT BRANCH

The regular meeting of the Bridgeport Branch was held in the Stratfield Hotel on Friday, April 5. The meeting was called to order at 8.45 by President Al Rosenthal. There were thirty members present. The roll call and minutes of the previous meeting were read and accepted. There were no special committee reports. Tom Chamberlain, secretary of the convention committee, reported that over fifty percent of the space for booths at the exhibit had been taken, and the program was complete and ready for the press. All members were urged to give their fullest support, and any members knowing of manufacturers who would be willing to take a booth in the exhibit were asked to give the particulars to the convention committee.

Election of officers was held in April instead of the May Meeting.

The following will be in office for the coming year. *President*, Joseph Sexton; *Vice-Pres.* Joseph Sterling; *Secretary-Treasurer*, Charles H. Costello; *Librarian*, Walter R. Meyer; *Serg't at Arms*, William Stratton. *Board of Managers*, John Oberender, William Thompson, Ben Kusterer. *Delegates to the Convention*, R. J. O'Connor, Joseph Sexton, Joseph Downs. *Alternates*, Walter Meyer, William Bridgett, Al Rosenthal.

The delegates to the convention were instructed to vote in favor of admitting assistant foremen to the society. Al Rosenthal, outgoing president, thanked the officers and members for the cooperation they had given him while he was in office. Joseph Sexton, newly elected president, asked that a rising vote of thanks be tendered the outgoing officers.

Open Meeting April 12

Mr. Walter R. Meyer, electro chemist of the General Electric Company, spoke to the branch and guests on the Finishing of Zinc Base Die Castings. The talk was illustrated with slides made by Mr. Meyer from micrographs prepared in his laboratory. These slides showed diffusion layers formed in copper plated zinc die castings, pits in die castings and other features of the talk. By means of a projectoscope, Mr. Meyer showed the stresses in deposited nickel when he plated a cathode of platinum foil on one side. The curling stress in the nickel caused the foil to bend, the bending increasing as the nickel deposit became heavier. At the completion of his talk, Mr. Meyer answered many questions that arose.

MILWAUKEE BRANCH

The regular meeting of Milwaukee Branch A.E.S. was held Thursday evening May 9, 1935 at Lipp's Hall, N. 3rd and W. Highland Ave. The meeting was called to order by Pres. Pat. Sheehan. Milwaukee Branch elected an entirely new set of officers for the year 1935-36. Most of the evening was devoted to this annual pastime. The following officers were elected: Pres., Robt. Steuernagel; Vice-Pres., Dexter Rhodes; Secretary-Treasurer, Roman Binder; Librarian, Al. J. Hermansen; Asst. Lib., H. Bornitzke, Board of Mgrs., H. C. Jaeger, Henry Binder and Jack Geissman. Delegates to Convention, Robt. Steuernagel, Dan Wittig

and Pat. Sheehan. Alternates, Al. J. Hermansen, and Jos. Bykowski.

A short discussion on cleaning was had. We are getting many new ideas. Milwaukee Branch intends to continue the educational work on cleaning, which we believe is about 98% of the work of Electro-deposition. With kindest regards.

FRANK J. MARX, Sec'y

WATERBURY BRANCH

Waterbury Branch A.E.S. held its annual meeting, Friday evening, May 10th in Engineer's Hall, President Tennant Elwin presiding. Although the weather was none too inviting, a heavy thunder and lightning shower prevailing during the evening, an exceptionally good attendance was present to hear William Schneider of the E. I. DuPont de Nemours & Co., deliver his talk. Several letters were read from the Convention Exhibits Committee and from action taken it looked as though Waterbury would be represented in the Branch Exhibits. On the paper program as furnished by the Convention Committee appears the names of four members of Waterbury Branch, William Delage, Walter Rowe, Ellsworth Candee and Benj. McGar. Letter from the Bridgeport Chamber of Commerce boosting the Convention was also read. Communication was received and read from the Anderson Branch relative to the action the Branch was to take in connection with the admitting assistant foremen to the A.E.S. and the inauguration of a sustaining membership class for firms. Communication was also read from the Hartford Branch asking that consideration be given the Resolution sponsored by the Hartford Branch and to be presented at the Bridgeport Convention. The annual election of officers resulted as follows: President, Tennant Elwin; Vice-president, William Cavanaugh, Secretary-Treasurer, William F. Guilfoile; Librarian, Ellsworth Candee; Board of Managers, William J. Gray, Sept. Marland and Richard Crane. Delegates to Bridgeport Convention, William F. Guilfoile, Wm. J. Gray and Joseph McConas. Alternates, Andrew Perrin, Wm. Delage and Sept. Marland. At the end of the business session the chairman introduced Mr. Schneider, the well known "Cyanide Bill," who delivered a highly interesting talk on "The Brass Plating of High Zinc Base Metals." The speaker strongly recommended brass plating preliminary to other finishes and exhibited samples showing the high throwing power of same. Favorable comment was expressed on the adhesion and general appearance of the work shown and the questions asked concerning same were many and varied. Owing to the fact that the speaker had to make train connections, the discussion which followed the talk was not as lengthy as many would liked to have had it. "Bill" promised to play a return date in the near future. After a rising vote of thanks to the speaker the meeting adjourned.

WM. F. GUILFOILE, Sec'y.

LOS ANGELES BRANCH

Minutes of the regular monthly meeting of the Los Angeles branch A.E.S. held April 10, 1935 at the Rosslyn Hotel. Pres. M. D. Rynkofs presided. The minutes and financial report of the previous meeting were read and accepted. The secretary read a letter from Mr. J. C. Hardy in Honolulu asking to be admitted to membership in the Society. The secretary reported having sent Mr. Hardy an application blank.

Mr. Francis reported having called on one of our members and discussing

with him the matter of giving out plating information to plant owners where he made electrical installations. This member agreed to cooperate in every way possible with the A.E.S. The application of Mr. Ray Bray was read and referred to the board of managers. Mr. M. McBennett, an old member of the Los Angeles Branch was a visitor. He told us of conditions in Denver where he has been for the past three years. Frank Rushton reported having called on several members who were behind with their dues in the Society. He had collected dues from some of them and suggested that some other member call on some of the ones he had missed.

The meeting was then turned over to the librarian who found the following questions in the question box:

Q. What would be the result of 3% iron in a chromium solution containing 3 lbs. chromic acid per gal?

A. The solution would be sluggish, have poor throwing power and the deposit may be cloudy.

Q. What kind of plating on brass is best to withstand the action of salt water?

A. There was much discussion but no definite answer.

Q. Can chromium be plated direct on aluminum?

A. Yes, but it isn't practical.

Q. Can zinc and cadmium be plated together successfully?

A. Yes.

Q. What effect does buffing composition have in a chromium solution?

A. Some kinds of it may develop tri-valent chromium in the solution.

Q. Is there any method of silver plating on glass?

A. Yes. See 1931 edition of Plater's Guide Book.

EARL COFFIN, Sec.-Treas.

Minutes of the regular monthly meeting of the Los Angeles Branch A.E.S. held May 8th at the Rosslyn Hotel. President M. D. Rynkofs presided. The minutes of the previous meeting together with the financial report were read and accepted. Letters were read from the New York and Andersons Branches dealing with the two proposed amendments to the constitution which would permit assistant foremen to become associate members, and would permit firms to become sustaining members of the society. The members voted to instruct our delegate to the convention to vote NO on both propositions. A letter from Mr. Hogaboom requesting each branch to have an exhibit at the convention was read. The members decided not to try to get up an exhibit this year.

Mr. Rushton suggested that at the forth coming convention the Supreme Officers be asked to protest to the proper authorities at Washington against the importation of foreign made goods into this country where the foreign made goods are manufactures under cheap labor conditions against which our local manufacturers cannot compete. The secretary was instructed to write a letter authorizing our delegate or proxy to bring this matter up at the convention.

Bills for per capita tax and secretary's fee for one half year were read and ordered paid. Ray Bray was elected and initiated as an active member of this branch. An application from Mr. J. C. Hardy of Honolulu for membership in the A.E.S. was read. The secretary was instructed to write Mr. Hardy asking for further information regarding his plating experience. The Board of Managers reported having audited the branch's books and found them O.K. The question of a

picnic on Memorial Day was discussed. Thornton Williams and Rushton were appointed as committee to arrange for this picnic.

The following were elected as officers for the coming year: President, R. U. Gripp; Vice-president, E. R. Williams; Secretary-Treasurer, Earl Coffin; Librarian, Max Golden; Board of Managers, M. D. Rynkofs, Harry Garside, and Frank Rushton; Delegates to the Convention, R. U. Gripp, E. R. Williams, and Earl Coffin; Alternates, Rushton, Rynkofs, and Garside. It was decided that if we had no delegate at the Convention we should tender our proxy to the St. Louis Branch.

The Board of Managers was instructed to get in touch with members who were delinquent with their dues and try to collect same. Mr. Terrio of Lasalco Co. was a visitor. He was introduced by Mr. Rushton.

The meeting was turned over to Ray Vasquez, the Librarian, who found the following questions in the box:

Q. What is best to use in a nickel solution to brighten the deposit and at the same time keep it soft?

A. The tendency is for all bright nickel deposits to be hard. Cadmium added will probably answer the purpose best.

Q. What is good to relieve the burning sensation caused by having the hands in cyanide?

A. A teaspoon full of lysol in a pint of hot water. Soak the hands in it.

EARL COFFIN, *Sec.-Treas.*

ROCHESTER BRANCH

The April meeting of the Rochester Branch was held on Friday night, April 26. Meeting called by Vice-President Chas. Hehr. Minutes of the previous meeting read and approved. Communications read and there were no comments. The application of Alfred K. Pritchard, 754 Blossom Road, Rochester, N. Y. was then read and accepted. After a short discussion on the new school for the study of electroplating which is to be started in Rochester soon, a discussion presented by Mr. G. A. Lux, one of the originators of the school, the meeting adjourned.

Application — Alfred K. Pritchard, 754 Blossom Road, Rochester, N. Y.

Reinstatement — Wallace A. Keefe, 18 Connecticut Ave., Jamestown.N.Y.

JUDSON R. ELSTER, *Sec'y.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held May 11, at the Atlantic Hotel, President E. G. Stenberg presiding and all other officers present. A new application was received from W. T. DeMott and a committee was appointed on same. Mr. J. A. Henricks was elected an associated member.

Two letters from Mr. G. Hogaboom regarding a Branch exhibit at the convention read and referred to a committee. A letter from Anderson Branch and one from Hartford Branch regarding the new proposed resolutions read and referred to our delegates.

The following officers were elected for the coming year. F. Herbst, President; E. Stepka, Vice-President; J. W. Hanlon, Secretary-Treasurer; O. E. Servis, Librarian; Board of Managers, W. Varnish, E. A. Lanz, Leo. Schmidt. Delegates to the Bridgeport convention, H. A. Gilbertson, F. J. Hanlon, O. E. Servis.

The Librarian found the following questions in the question box.

No. 1. A nickel solution is more concentrated at the bottom than at the top, will this solution become the same density on standing, that is without any agitation.

Answer. Not unless it has some agitation to start with, one member stated that he very carefully added water to a nickel solution and did not agitate same and has tested this solution for about one year and the bottom is still more concentrated than the top.

No. 2. Is there any cleaner still or electric that will remove polishing grease from steel parts without washing the parts in gasoline or any other solvent?

Answer. Yes. Soak in a soap cleaner first, then run in an electric cleaner.

No. 3. What causes anodes used in a chrome cleaning tank to corrode in a few weeks? These anodes were Monel Metal plated with Nickel.

Answer. Impurities in the water.

No. 4. When chrome plating buffed nickel plated steel, what causes brown streaks and spots, when ratio of 100 *to* 1 *sulphate content is maintained?*

Answer. Lack of sulphate, insufficient current, improper cleaning with wrong type of acid dip.

J. W. HANLON, Secretary.

PHILADELPHIA BRANCH

President's Letter

Election of Officers at next meeting, Friday, May 17th, 8 p.m. sharp, at the Harrison Laboratory, U. of P., 34th and Spruce Streets. The nominees are as follows—President, Al. Hirsch; Vice-President, Philip Kuzeknabe; Secretary-Treasurer, George Gehling; Librarian, R. Jackson; Board of Managers,(3) three to be elected, Harry Long, Roberts, Barr, Uhl, Eddows; Delegates to the Convention, (3) three to be elected, Underwood, Uhl, Gehling, Geo. Long; Alternates, (3) three to be elected, Jackson, Kuzeknabe, Barr.

GEORGE M. LONG

DETROIT BRANCH

A regular meeting of the American Electro-Platers' Society, Detroit Branch was held on Friday evening, May 3rd, 1935, at 8:00 P.M.: at Hotel Statler, Col. Jos. H. Hansjosten presiding. The minutes of the previous meeting were read and approved. There were no new applications for membership. The Board of Managers reported favorably on the following eight applicants, and they were unanimously elected to membership: Frank Watt, W. H. Ross, R. J. Green, Sol Burg, Frank Lester, Ralston G. John, Harry C. Crooks, James W. Overton. Mr. Benjamin Fry, Lansing, Michigan, was suspended.

Correspondence: Two letters from Mr. Geo. Hogaboom regarding exhibits of plating for the coming Convention were read and placed on file. Also a letter from New York Branch, Anderson Branch, and Hartford Branch, were received regarding the proposed amendments to the Constitution regarding admission of assistant foreman platers and creating sustaining memberships. As Detroit Branch had already taken action on these propositions, these letters were not read by the Secretary but were placed on file.

Bills were all passed by the Board of Managers before the meeting. Mr. Soderberg was then given the floor and proposed that we as Detroit Branch of the A.E.S. endorse a movement in Detroit fostered by the Engineering Society to form a technical society of all the industrial societies in Detroit, such as electrical, heat-treating, chemical, plating and sundry organizations and that Detroit Branch sustain such a society by becoming a

member of same. This motion was seconded by Mr. Charles Eldridge. Mr. Spencer amended the motion that discussion on this question be delayed. The outcome was that Mr. Spencer's motion was turned into a motion to table the proposition. This was carried.

Then followed the election of officers: For President, Mr. W. W. McCord was nominated, and there being no other nominees, the Secretary cast a white ballot for Mr. McCord as President. The President declared Mr. McCord unanimously elected President for the ensuing year. For Vice-President, Mr. Gordon Spencer being the only nominee, he was elected in the same manner. For Secretary-Treasurer, T. C. Eichstaedt being the only nominee followed the same course and was unanimously elected Secretary-Treasurer. For Board of Managers, Messrs. Chas. Beaubien, A. B. Wilson and George Kutzen were elected on the Board of Managers for the ensuing year.

Convention Delegates: The nominations were as follows: Messrs. Hansjosten, Spencer, Brockway, Harris, Wilson, Burrows, Eichstaedt. Three of these to be elected as Delegates and three alternates. It was decided that the three receiving the most ballots would be the delegates and the three next in order would be alternates. The results were as follows: Hansjosten, 29; Eichstaedt, 29; Spencer 24. These three were declared Delegates to the Convention. As Alternates, Brockway, receiving 17, A. B. Wilson, receiving 15, Burrows receiving 7.

Mr. Chester Marshall, nominated as Librarian. There being no other nominees, Mr. Marshall was unanimously elected to fill this office.

A telegram was received from Frank Lester, one of the new applicants, who had just been elected to membership, stating he was ill and could not attend the meeting. This was very thoughtful of Mr. Lester and very much appreciated by the Society, as it shows the interest taken in becoming a member of this Society.

The American Electro-Chemical Society then joined our meeting, and Chairman Hansjosten introduced the speaker of the evening, Dr. F. A. Rohrman, Professor of Michigan College of Mining and Technology. His subject was "Corrosion of Metals". Dr. Rohrman is well versed on this question of corrosion and has carried on very extensive research work regarding same and detailed some very interesting, actual, practical tests with results of same, showed many photographs and also had many specimens of the actual metal upon which corrosion tests had been made. This was very educational and very interesting and everyone present certainly profited by having heard this talk and seeing these specimens and photographs. The Society of the whole gave a rising vote of thanks and much applause to Dr. Rohrman for his talk. He has not as yet given me a copy of the paper, which I expect to recieve from him, which I will send in for publication. The meeting adjourned until the first Friday in June, when the new officers will be installed and the Board of Managers will make their report.

T. C. EICHSTAEDT,
Secy.-Treas.

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The Hanson Van Winkle-Munning Company, Matawan, N. J., announces the development of a new anode named Zam (zinc, aluminum, mercury). It is stated that this new anode is not attacked by either acid or cyanide solutions until the current is applied; that consequently the anode is free from sludge, and can be completely used up in a zinc solution and that no sludge will be found in the bottom of a tank regardless of how long the anodes are used. No sludge on the anode means no anode polarization. Therefore, practically no increase in voltage will be required at any time, either at the start or during the plating, whether the run is short or very long. This permits setting the rheostat at a required point with complete assurance that the desired amount of zinc will be deposited in the given time.

When ordinary zinc is used, a higher voltage is necessary to obtain the required current density as the anode coats over with decomposed zinc. The higher pressure results in more hydrogen being included in the deposit and therefore heavy deposits become brittle and non-adherent. On wire or BX cable, for instance, with ordinary zinc anodes in the solutions commonly used, a deposit that will withstand more than two preece tests is difficult to obtain. With Zam anodes it is stated that a deposit can be obtained, without any extra precautions, that will withstand six Preece tests. The absence of hydrogen in the deposit due to the ability to plate at high current densities and low pressure makes it possible to obtain a ductile, adherent deposit that can be easily formed without any danger of cracking or abnormal distortion.

Cyanide zinc solutions can be maintained at a fairly constant metal content by the use of steel containers and ball anodes. As the anodes do not develop any coating while the plating is being done and remain clear and clean, there is no contact resistance between the Zam balls. A container of Zam balls will give higher efficiency than a continuous bar anode.

The manufacturers state that a Zam anode can be used in cadmium solutions and will convert such solution into a zinc without any trouble whatever. The plating operation can be carried on without interruption until the cadmium solution is completely converted to a zinc solution. Then the highest efficiency of zinc deposition from a cyanide solution can be obtained.

Zam anodes are being used by prominent wire and cable manufacturers, leading automobile manufacturers, hardware manufacturers, and automotive accessory manufacturers.

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